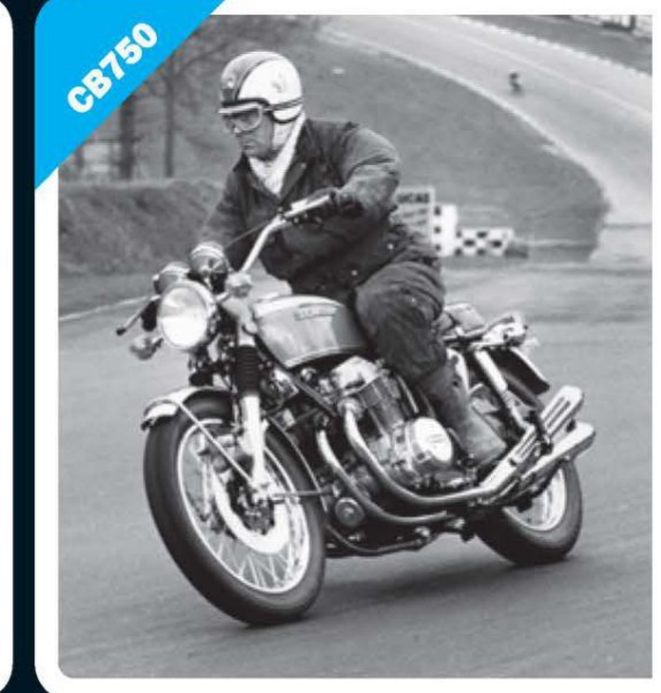
In association with classic motorcycle mechanics

1969-1983

CLASSIC roadtests REVISITED

THE MOTOR INDUSTRY RESEARCH ASSOCIATION FILES

CELEBRATING JAPANESE MOTORCYCLING'S GOLDEN AGE



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TESTED INSIDE

Honda CB750 ■ Bimota SB2 ■ Suzuki 1000G and BMW R100T ■ Kawasaki Z1-RTC
Honda CB750F/Suzuki GSX750/Kawasaki Z750 ■ Yamaha RD250/400 ■ Laverda Jota ■
Kawasaki Z1 ■ Honda 400/4 ■ Kawasaki Z650 ■ Suzuki GT750 ■ Honda CBX550/ Kawasaki
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FOREWORD

THE 1970S WERE A GOLDEN AGE for motorcycling. A new wave of high performance Japanese machines broke new ground in speed and handling with every year that passed. Two stroke 250s with performance to beat a 500cc British twin from just ten years earlier. Four cylinder, race developed superbikes that left any other vehicle standing.

This book is a fascinating document of that time. A collection of stories written under the title Mira Files, by John Nutting – one of a handful of road testers who had the privilege to ride every bike of that marvellous era.

The fascination comes because these are the opinions of the time, not rose tinted, hindsight by someone who never had the context to go with the ride.

The Mira files takes its name from the Motor Industry Research Association's Nuneaton test track where all the machines of the day were put through their paces. They have been a mainstay of *Classic Motorcycle Mechanics* magazine for the last ten years; this book brings a selection of them together for your enjoyment.

Magazines change over time, page styles get redesigned and so the layout of the features change occasionally. We discussed whether the features should be redesigned for this collection to give them a uniform feel, but in the end decided to leave them as they were, to maintain that original feel.

In that same spirit of originality, we also left the text untouched which means you might raise a few eyebrows when certain dates are mentioned. Please bear in mind that those dates are relevant to when the article was first published (the dates of that are close to the headline for each article.

I hope you enjoy reading it as much as we enjoyed putting it together.

Steve Rose

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A CLASSIC MOTORCYCLE MECHANICS PUBLICATION

classic motorcycle mechanics

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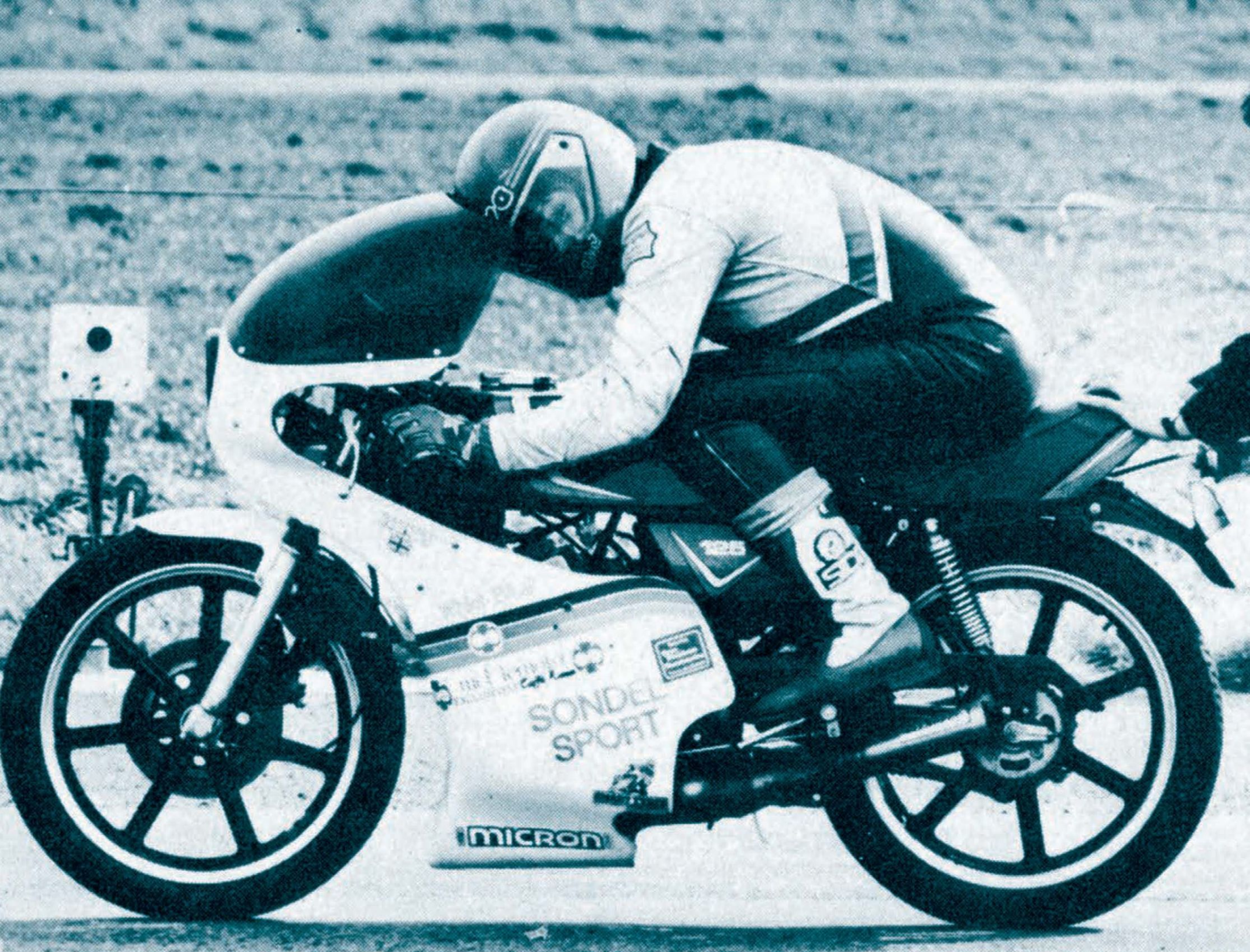


INTRODUCTION

THE SERIES OF ARTICLES IN *CLASSIC MOTORCYCLE MECHANICS* called the MIRA Files originated from an idea that had been germinating for a couple of months towards the end of 2000.

My archives of material from when I'd worked for Motor Cycle, the weekly newspaper, in the 1970s contained data from the performance testing I'd carried out at the Motor Industry Research Association's proving grounds near Nuneaton in the Midlands. While this data had been used to create the performance panels that were part of the road tests, there was much that hadn't been used and more importantly hadn't been put into much of a comparative context.

So why not publish a series of articles that featured how the motorcycles of the 1970s, the lifeblood of Classic Motorcycle Mechanics and its readership, actually performed when they were new?

Editor at the time Bob Berry liked the idea as an extension of my previous contributions, and so the first of the series appeared in the January 2001 issue, featuring one of the most celebrated superbikes of the era, the Honda CB750 Four. And the series continued, month by month, supported by pictures of the motorcycles of that period, providing an alternative insight into the classic period when the Japanese factories were becoming dominant in every sector of the industry.

I'd joined Motor Cycle early in 1972 as a trainee reporter and amazing though that was to me – the office was in Fleet Street, centre of the newspaper world – it was even more dream-like to be getting paid to ride new motorcycles and report on their performance and behaviour.

I found that I'd stepped into a tradition for publishing road tests that were steeped in detail and supported by the use of rigorously-obtained performance figures. More to the point, these figures were measured in a way that offered repeatability, so that sensible comparisons could be made.

If that sounds almost scientific, then that was probably the intention. One of the mementoes from the period that I still have is the check list given to me by editor Harry Louis of the items that were necessary to be mentioned in every test report, right down to ease – or otherwise – of day-to-day maintenance.

In the 21st century, the most potent motorcycles have maximum speeds that are almost impossible for the average rider to achieve, and even performance testing them has its challenges even with the use of GPS and compact data gathering equipment.

In the 1970s, the proving ground at the Motor Industry Research

Getting an RD125 to do 100mph involved a slippery fairing, a Stan Stephens engine tune and a Stan Stephens helping hand as well. Cuban heels reputedly added 0.8mph to the top speed (Stan's not the bike).

JOHN NUTTING has been a motorcycle enthusiast since riding a cousin's 500cc Ariel in a field in the Isle of Man. His first machine was a 125cc Lambretta bought the day after President John F Kennedy was assassinated in 1963, but scooters were soon forgotten after seeing Manx Nortons being raced in the Southern 100 races. A Norton Dominator 99 was acquired and he still owns a Norton, a 1974 Commando 850 Roadster.

The interest in motorcycles led to a mechanical engineering qualification but an advertisement in The Motor Cycle looking for a trainee reporter couldn't be ignored. Miraculously, John got what he regarded as his dream job, riding bikes for a living as a road tester and later reporting on road racing events around the world.

John went on to be editor of the monthly Which Bike?, briefly was technical editor of Cycle World in the US and help found Motorcycling Weekly. He has road raced and won a Bantam Racing Club championship on a home-built machine.

He subsequently moved into business journalism and is currently editorial director of a publisher that covers the packaging industry. But he never stopped writing about motorcycles, and has contributed to a number of titles worldwide, the most regular being to Classic Motorcycle Mechanics with the MIRA Files series which started in January 2001.

He is married with two teenage daughters and lives in Kent.

Association (MIRA) provided a huge expanse of test tracks including a triangular circuit with banked corners. For measuring speeds, we used the timing straight, 1000 yards long across which near either end were located pairs of light beams, which when passed through by a vehicle would trigger the electronic equipment in a tiny hut next to the middle of the straight.

It seemed like you had an immeasurable amount of space so that even at 130mph or more, most machines felt like they could be faster.

It provided a tough testing regime in which you'd wind the motorcycle's engine to the redline through the gears and hold it, flat out in a racing crouch, until it was necessary to slam on the brakes to avoid ending up in the sand traps. Weak clutches and braking systems would be exposed.

The repeatability of the figures came from measuring the top speed and acceleration in both directions, the 'mean' top speed being an average, that I found to be pretty accurate despite variations in wind speed.

That tradition had come from the days after the Second World War when MIRA was set up in 1948 at the former aerodrome of RAF Lindley to provide research and development facilities for the British automotive industry.

Factories could become members of the association, as did the motorcycle manufacturers of the day, and so did Iliffe, the publisher of The Motor Cycle, to exploit the facilities. From the style of the road tests from the early 1950s it's clear that the performance was assessed at a test strip, which was more than likely to be MIRA.

One of the joys of being at MIRA was that you'd meet up with the factory testers from Norton, Triumph and Dunlop who were the hardest and most skillful riders I'd ever met, not to mention having the sharpest of wits.

After leaving Motor Cycle at the end of 1978, I moved to Which Bike?, the monthly magazine where I angled again to get access to the facilities at MIRA. During the 1980s, speeds of the superbikes increased to more than 150mph so it was necessary to use the nearby parallel straights with 70mph connecting curves at either end. They had no timing equipment so the early radar guns were used.

In time the timing straight at MIRA became irrelevant for testing even 600cc motorcycles that could reach 160mph or more, and other locations such as the two-mile straight at Bruntingthorpe in Leicestershire provide the space.

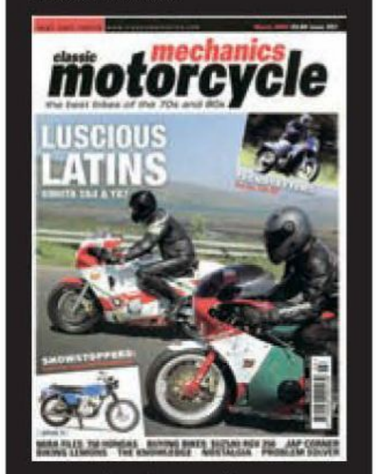
Since 2001 the facility has been called MIRA Ltd, and the operations are a £-multi-million business that mostly offers its members design consultancy although the proving ground gives a range of conditions for testing. The timing straight is no more, though it returns to me as a vivid memory whenever I hear a skylark like those that would rise from the fields between the tracks, singing its plaintive song as a motorcycle crackled and pinged while it cooled in the summer heat.

I like to think the MIRA Files series is a valuable invocation of those classic machines from the 1970s and 1980s. And now that the series is in its 11th year the time is right to reproduce them in a book. I hope you enjoy it.

John Nutting

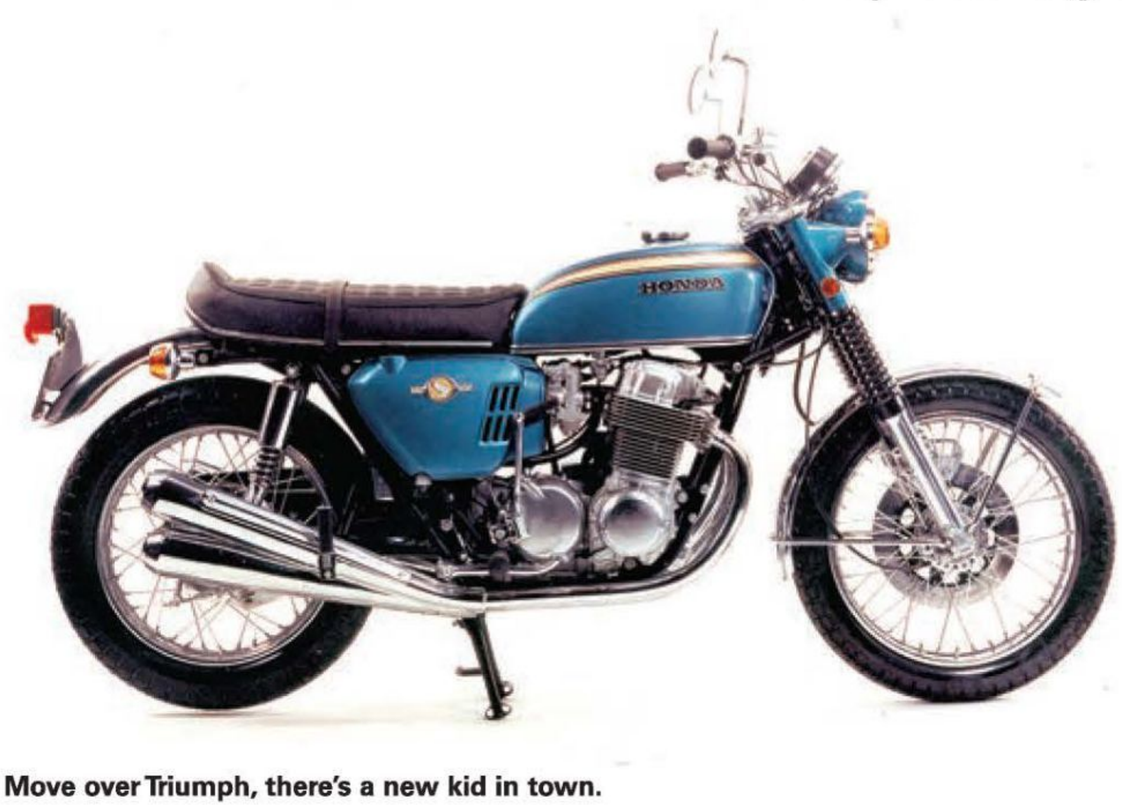
This Early pre-production prototype was shown at the October 1968 Tokyo Auto Show

Originally printed in the March 2009 issue of *Classic Motorcycle Mechanics*



Race to production

After winning handfuls of world road racing titles in the 60s, Honda raced to get the CB750 Four into production 42 years ago in 1969. John Nutting charts its development



Move over Triumph, there's a new kid in town.

With four decades having passed since the launch of the Honda CB750, it's no wonder that the history of the world's first mass-produced four-cylinder motorcycle has been comprehensively documented.

Fans of the machine that heralded the Superbike era have researched in painstaking detail how it evolved, and perhaps no other Japanese machine has been so well studied. Yet there still appear to be gaps in the accumulated knowledge.

This month is another anniversary for the bike, for it was 40 years ago, in March 1969, that the CB750 was first shown in the UK.

Two bikes were revealed to the press and later at the Brighton Show in April, coincidentally with presentations in Japan, Germany and France. The bikes shown in the UK were what are described now as pre-production models, shown in advance of the bike's delivery to dealers later that year.

Despite being six months after the bike's first appearance at the Tokyo Automobile Show, and around eight weeks since it was displayed to US dealers in Las Vegas, precise information about the CB750 was still sketchy. Remarkably, the December 1969 issues of some US magazines

When *Motor Cycle* first mentioned a 750cc Honda in August 1968, they thought it was going to be a twin.

Motor Cycle

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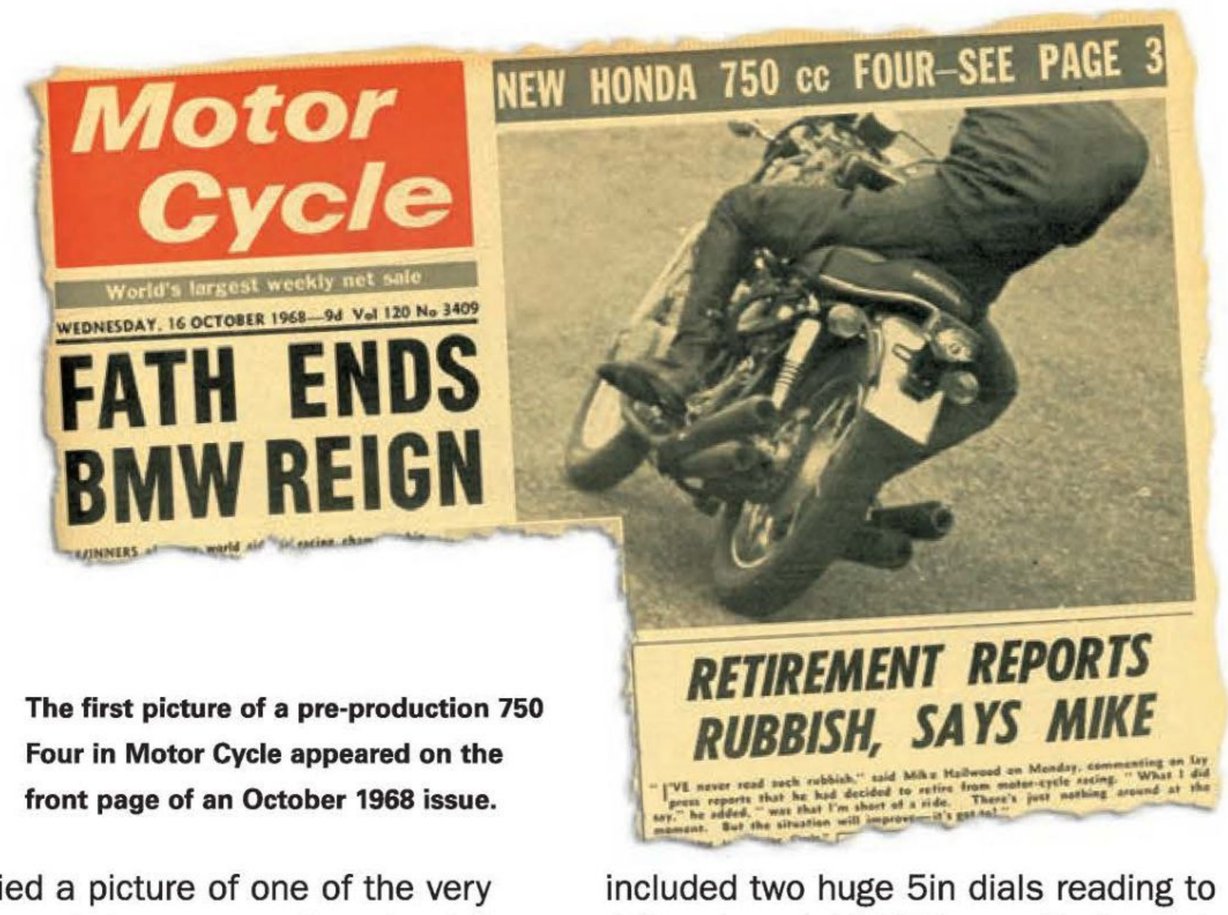
WEDNESDAY, 21 AUGUST 1968—9d Vol 120 No 3401

Banks pipped at the post

HONDA PLAN 750 cc ROADSTER FOR 1969

Davis nears British | Goldfinger Smith | AT LAST | Roberton fit



Motor Cycle

World's largest weekly net sale

WEDNESDAY, 16 OCTOBER 1968—9d Vol 120 No 3409

NEW HONDA 750 cc FOUR—SEE PAGE 3

FATH ENDS BMW REIGN

RETIREMENT REPORTS RUBBISH, SAYS MIKE

The first picture of a pre-production 750 Four in Motor Cycle appeared on the front page of an October 1968 issue.

carried a picture of one of the very early prototypes, even though a later pre-production machine had been on show along with an engine at Tokyo. News then didn't travel anything like as quickly as it does today.

So it is unsurprising that there was no comment on the fact that pre-production CB750 machines shown to the dealers and press in the US and Europe were different from the one seen at the Tokyo show.

Dutifully, it was reported that the CB750 had a single-overhead-camshaft four-cylinder engine with a bore and stroke of 61 x 63mm, giving a swept volume of 736cc. On a compression ratio of 9 to 1 and breathing through four Keihin carburettors, it developed a claimed peak power of 67bhp at 8000rpm - enough, according to Honda in Tokyo, for a top speed of 125mph. The engine had plain steel-backed shells for the five-bearing crankshaft with a six-pint lubrication system fed from an oil tank below the seat. This also lubricated the gearbox which had five ratios with a left-side lever.

Apart from the four swooping exhaust pipes and silencers that evoked memories of Honda's world championship - winning racers from earlier in the decade, other visible clues to high performance included the massive hydraulically-operated 12in disc brake. Instrumentation included two huge 5in dials reading to 150mph and 11,000rpm with the red line starting at 8500rpm. This was the business.

Yet the Honda CB750's debut in the UK was just one of a series of tight targets in a development programme that had started barely two years earlier, not long after the factory had decided to pull out of Grand Prix racing in 1966.

Honda's biggest road bike at the time was its CB450 dohc twin, which although capable of giving the mostly British 650cc twins sold in the US a run for their money, was nonetheless regarded as a bit of a toy. The CB450 wasn't a 'big bike'.

Yoshiro Harada, who was put in charge of the development project by company president Soichiro Honda, and had visited the US on a fact-finding tour in the summer of 1967, decided to develop a bigger model after US dealers called for a big bike and "the bigger the better".

Harada wasn't quite sure how big but it was clinched when he found out that Triumph was developing a 750cc triple, and that Kawasaki had a project for a big bike. So by October 1967, its capacity was determined. It would be 750cc. And its power was determined by Harley-Davidson's 1200cc V-twins. They turned out 66bhp, so the 750cc Honda would have more. The target would be 67bhp.

HONDA'S PRODUCTION CB750 MODEL BY MODEL

YEAR	MODEL	FROM ENG NO	FROM FRAME NO	FEATURES
1969	CB750	1000001	1000001	Gravity-cast engine cases
1970	CB750	1007415	1007415	Die-cast engine cases
1971	CB750K1	1044806	1044650	Linkage for carbs, large side panels with badge
				Black brake caliper, no chain oiler
1972	CB750K2	2000001	2000001	Chrome headlamp mounts, black h/l shell
				Script '750 four' on side panels
1973	CB750K3	2200001	2200001	Revised tank graphics, detail updates. Not UK
1974	CB750K4	2300001	2300001	US market
1975	CB750K5	2372115	2500001	US market
1976	CB750K6	2428762	2540001	US market
	CB750F1	2515094	2000003	Revised styling, 4-into-1 exhaust
1977	CB750K7	2372115	2700009	Bigger fuel tank, revised carbs, exhausts
	CB750F2	2600004	2100011	73bhp black engine, revised graphics
1978	CB750K8	3000001	2800001	Revised graphics
	CB750F3	3100001	2200001	Revised graphics and side panel emblem

Source: www.sohc4.net

The ultimate

Above: Just about the ultimate in road - going motor cycles — the 80 hp four - cylinder 750 cc Honda — sensation of the Tokyo Show

Right: Valve operation is by single overhead camshaft. A separate carburettor feeds each cylinder. Peak revs are 10,000 rpm. Gear box is a five-speeder

Below: Neat and tidy. The beautifully finished in-line four fits neatly into an orthodox duplex frame. A hydraulic steering damper is fitted

Below right: extra stopping power for the Honda is provided by this hydraulic disc brake coupled to a new front hub

Right How *Motor Cycle* first reported on Tokyo Show appearance of The sensational CB750 Honda Four.

In December 1968, one of the Early pre-production prototypes was ridden for the American magazine *Cycle World*.

'SAND CAST' PUTS A SMILE ON CHRIS'S FACE

Chris Rushton's CB750 now has 108,000 miles on the clock

A Honda CB750 with an engine number as low as 1005298 makes it one of the very earliest to have been manufactured soon after the first mass-produced four-cylinder motorcycle was launched in 1969. So you'd understand if its owner would want to preserve it in aspic.

Not Chris Rushton. The 49-year-old mechanical engineer from Sheffield rides his CB750 more than the other machines in his collection, which includes both classic and modern Hondas. A stalwart of the Sand-cast Only Owners Club (SOOC), Chris has clocked up 86,000 miles since he bought the bike in 1990, and it now shows 108,000 miles on the odometer.

As keen as they come, Chris has been riding year-round for 32 years, commutes on a CB400F and has never owned a car. He has three CB750 Fours, two of which are so-called 'sand cast' versions which is the description the SOOC applies to the first 7414 machines made before Honda changed its crankcase manufacturing process to gravity die casting, making them easy to spot for those in the know.

While the second sand cast CB750 is currently being restored and the third CB750 is an immaculate 1971 CB750K1, the high-mileage bike is Chris's favourite.

It was imported into the UK from California in 1989 and bought by Chris as a non-runner with some missing parts and 22,000 miles on the clock, which he thinks was genuine. He replaced head gasket and the parts including the side panels, air box and footrests, registered the bike and clocked up 10,000 miles in its first two years.

He rebuilt the engine at 32,000 miles to replace the chains and tensioners, powder-coated the frame, repainted the tank, panels and other parts using Halford aerosols, and re-plated the chrome and zinc, since when the bike has been used every summer, clocking up to 8000 miles a year. It's been used for evening and weekend runs, holidays to Scotland and the Isle of Man and has been to most places in the UK.

"The highest one-day mileage has been 450," says Chris. "Seat comfort is better than that of my VFR, although of course the upright riding position and lack of fairing can make long distances at high speed rather tiring. Probably won't lose my license on this one due to excessive speeding!"

Despite the high mileage, the engine still has its original pistons, rings, valves and crankshaft big-end and main bearing shells and even the final drive sprocket. "It burns very little oil and averages 50mpg," says Chris.

"I am rigorous regarding servicing, as oil and time are a lot cheaper than engine rebuilds," he says. "I replace the drive chain every time the rear tyre is changed and have so far avoided the chain-through-the-crankcase scenario which afflicted quite a number of CB750s.

"I do far more miles on this than any of my other bikes, including the modern ones such as the VFR and CB1300. Why? Apart from the fact that it is such a significant motorcycle within the overall story of motorcycling, for me it has character, is dependable, makes a great sound through those original 'HM300' exhausts (which are the same ones as fitted to it in 1990 when I bought it), handles and brakes reasonably well if you accept that it is 1970s technology, and in performance terms is still capable of running with modern traffic.

"It still puts a smile on my face, even after all these miles," adds Chris. "The other aspect of classic motorcycling is the social side of things. I have met numerous like-minded people who I now consider friends and much more so than when riding modern bikes."

A 20-strong team of engineers was mustered, and development started in February 1968. Targets were established:

- That the bike should offer stability when cruising at 90 to 100mph yet be flexible enough for traffic manoeuvring.
- It should have strong and reliable braking
- There should be minimal vibration and noise to reduce rider fatigue, a comfortable riding position and easy to use controls
- Large and reliable lighting and instrumentation should be used
- It must have an extended service life and easy maintenance
- Employ original designs using new and better materials, and production technologies.

Honda had already built up huge reserves of information from its racing activities. It also set up computer-based systems that not only eased the planning of the prototype phase, design changes, hardware modifications, and testing, but also reduced the time needed to plan a line for mass production of the machine.

Nonetheless the team was moving into uncharted territory. The CB750 four was Honda's first bike with an engine using plain shell bearings. This enabled the engine to be manufactured more cost-effectively than those using pressed-up cranks with roller bearings, but Honda's engineers had to develop new machining and assembly techniques.

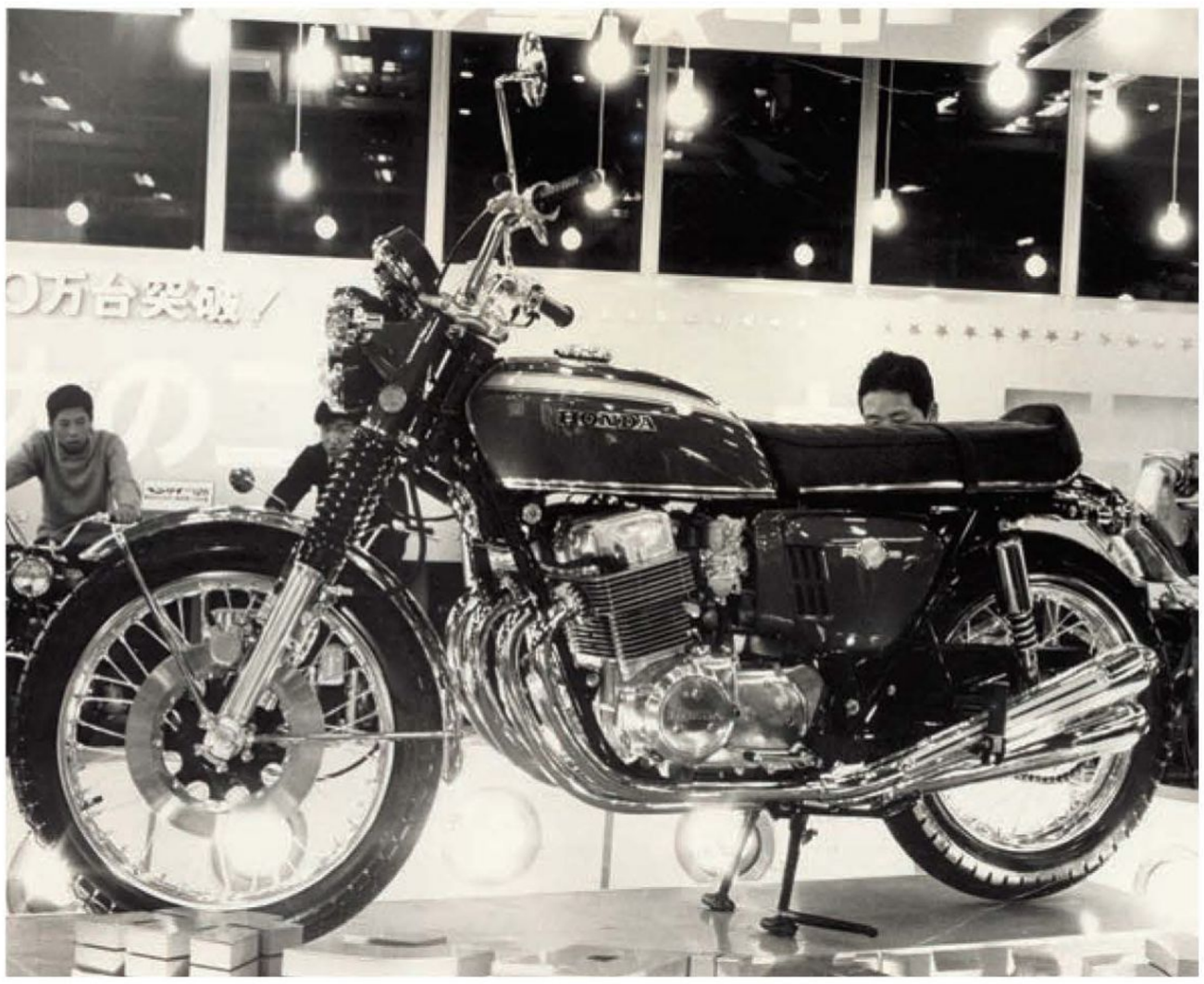
The design of gear drives in engines with plain bearings had yet to be properly developed, so twin roller chains were used for the primary drive. Symmetry for the engine meant that the chains drove from the centre of the crankshaft, along with the chain for the overhead camshaft. But with the drive going direct to the gearbox mainshaft, the five-speed cluster was positioned more to the left side, making it impossible to take the final drive to the rear wheel direct from the layshaft. So a countershaft sat behind the layshaft, lengthening the engine but with the added benefit of not placing chain drive loads through the gearbox.

Harada says that the possibility of using twin overhead camshafts, as on the race bikes, was an option that was planned for three or so years after the CB750's introduction. Reliability, and the lower cost, of a single camshaft opening the inlet and exhaust valves through rockers with screw clearance adjusters, probably took precedence. Carburation, with four 28mm Keihin units connected to the inlet ports with heat and vibration-isolating rubber stubs, looked complex but was a simple multiplication of common practice with more precision, only upset by the use of four control cables connecting with a junction unit to a single cable to the twistgrip.

Many features of the CB750 design would be familiar to motorcyclists of the day but they were more competently executed, mainly because Honda's engineers were starting from scratch with no preconceptions or culture to influence them.

So while the oil circulation system generously supplied the engine's lubrication and cooling needs from a modern trochoid pump, it was a dry-sump system fed from a separate oil tank, like most British bikes, but with a full-flow filter easily accessible on the front of the crankcase.

Right from the start, the electrical system was fed from a high-output field-excited alternator on the left hand end



Imagine the stir the Honda caused at the 1968 Tokyo Automobile Show.

In December 1968, an Early pre-production prototype of the type shown at Tokyo two months earlier was tested by Honda against a Triumph Trident 750 in the deserts of west coast USA.

of the crankcase, but the ignition used a pair of simple contact breakers and double-ended ignition coils. Reliable solid-state electronics hadn't yet been developed for ignition systems. The ignition lock was mounted under the front left-hand side of the large fuel tank rather than in view between the instruments. Self-starting had been developed, though, and the CB750's electric motor spun up the engine breathlessly through an elegant one-way clutch behind the alternator.

The CB750's cycle parts were a mix of the traditional but with a modern twist. Wheels were the normal 19in front and 18in rear steel rims supporting bias-wound tyres with inner tubes. Geometry, with a 57.5in wheelbase, only erred from the familiar by the use of a slightly steeper steering head angle of 63 degrees and modest trail of 3.7 in, chosen no doubt to provide lighter handling at the speeds that new riders would be first testing the bike.

The steel tubular frame was tough, a welded structure with twin spars leading back from the bottom of pressed steel steering head assembly to the top of the rear shock mounts and braced by a single triangulating tube. Two more spars looped under the engine back to the swing arm pivot. Suspension was nothing new either – a telescopic front fork and De Carbon-style rear shocks – and would bear the brunt of later criticism.

Apart from the four-cylinder engine, the other eye-rivetting feature was the Honda's disc brake, which on a mass-produced motorcycle was new for its hydraulic operation. We'd seen cable-operated discs on MV Agustas (and even Lambretta scooters), and race bikes were using Lockheed discs, but the Honda arrangement (designed with help from brake specialist Lockhart) used a pivoting arm that supported the single-piston caliper and looked like a neat design. With hindsight we know better, but at the time it was a powerful statement.

Of the prototypes that were made during 1968 for testing and evaluation, there is scant information. Be assured there are many Honda fans dedicated to recording and even finding them. One such is Steve Shaw in Colorado, who runs the Sand Cast Only Club web site for fans of the very early CB750s, and shows a number of images of the bike that he classifies as Early-prototype and Late-prototype as a means of identifying what could be no more than four machines. The Early version seen in grainy images featured CB450 fuel tanks and drum brakes, while the Late version had the final tank shape though still with a drum. Indeed a bike looking like the Early-prototype has been restored recently in the US that purports to be an original.

The design was almost complete by the time the CB750 was given its world launch at the October 1968 Tokyo show. The bike shown was what Steve Shaw calls an Early-Pre-production machine with all the features seen on later bikes but with significant differences.

For example, the carburettors are racing-style Keihins with enclosed opening mechanisms, the left side engine cases are more squared off around the starter motor drive, the disc brake centre has fewer spines and the side panel badging is simplified to a small Honda logo. A machine like this fitted with a touring fairing and saddle bags was tested

EARLY CHANGES

BULLETIN DATE	FROM ENGINE NUMBER	NATURE OF CHANGE
18 JUNE 1969	CB750-1001081	Larger generator rotor bolt to prevent loosening
19 JUNE 1969	CB750-1000264	Stronger seat spring
1 AUG 1969	CB750-1004006	Air cleaner case revised to prevent stress
9 AUG 1969	CB750-1003528	Revised wider engine sprocket with longer shaft
10 AUG 1969	CB750-1000425	Gearbox drum stopper changed to improve shift action
26 AUG 1969	CB750-1003434	Revised speedo mounted to prevent turning
31 AUG 1969	CB750-1002381	Revised side stand with projection
16 SEPT 1969	CB750-1003732	Thicker chain split link
30 SEPT 1969	CB750-1005451	New clutch springs giving higher plate pressure to prevent chattering
25 OCT 1969	CB750-1005307	Special gearbox mainshaft bearing introduced
25 OCT 1969	CB750-1009554	Oil filter changed to ribbed type, bolt torque changed
30 OCT 1969		Revision of break-in period, reduced 6,500 rpm limit to 5000rpm up to 600 miles because of occasional big-end seizures caused by hard riding during break in
5 NOV 1969	CB750-1001938	Fuel tank designed with protrusion for fuel tap
14 DEC 1969		Oversize main jets available 110-115-120-125
23 DEC 1969	CB750-1007415	Crankcases changed: gravity cast to die cast
30 DEC 1969	CB750-1011719	Removal of throttle grip adjuster
28 JAN 1970	CB750-1010338	Wider inlet rocker shaft bearing faces
30 JAN 1970	CB750-1014996	Exhaust valve stem seals discontinued, new ex-valve guide contour
30 JAN 1970	CB750-1015593	Grommet on mudguard for speedo cable
30 JAN 1970	CB750-1016997	Dampers revised in rear wheel drive
16 FEB 1970	CB750-1017630	New carb assembly with longer slides and heavier springs
16 FEB 1970	CB750-1017342	Throttle cables to suit new carbs (kit offered with heavier cable and fittings)

> "APART FROM THE FOUR-CYLINDER ENGINE, THE OTHER EYE-RIVETTING FEATURE WAS THE HONDA'S DISC BRAKE, WHICH ON A MASS-PRODUCED MOTORCYCLE WAS NEW FOR ITS HYDRAULIC OPERATION."

John Nutting rides an early CB750 in 1998 owned by Graham Bentman.

THE FIRST CB750 IN EUROPE - BY DAVID DIXON

Within minutes of riding the first CB750 in Europe, I was convinced not only that Honda was onto a winner but that it would set a standard which competitors would strive to reach, or perish.

My first experience of the bike was on the Nürburgring race circuit in Germany's Eifel Mountains, 14 miles of every type of corner, many of which were approached over blind rises followed by downhill twists and turns.

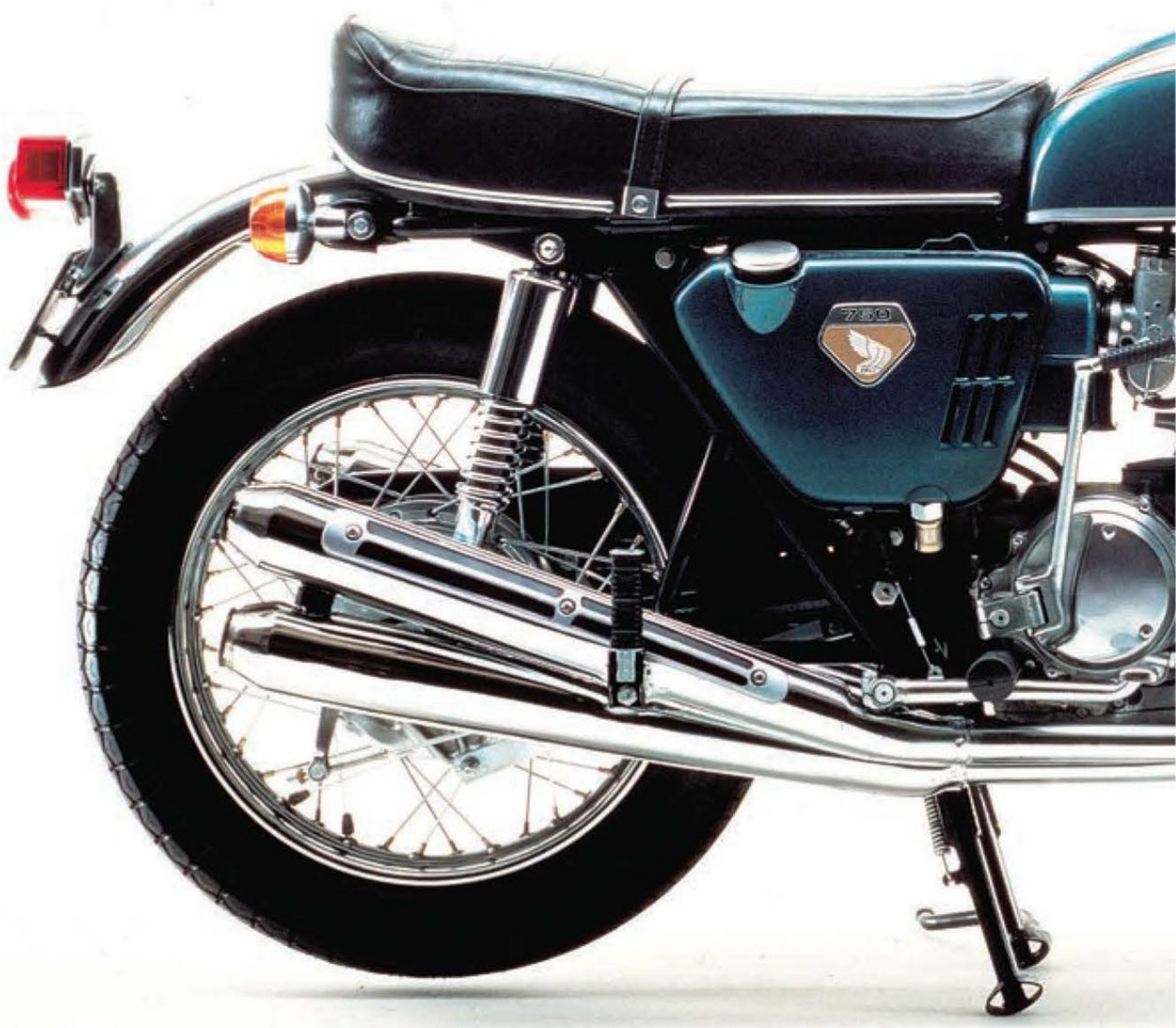
As road tester for *Motor Cycle* I was in company with Ernst Leverkus of *Das Motorrad* magazine who, for a comparison had brought along a Munch Mammut – the most expensive, exotic, hand-built, European machine powered by a 1200cc NSU car engine – producing 90 bhp, against the mass-produced Honda's claimed 67bhp. What some might suggest as an unfair comparison was levelled by the Nürburgring's Machiavellian layout.

I had to use the Mammut's stronger punch out of corners to stay with Ernst, who exploited the Honda's ability to hustle quicker through the circuit's fast sweeps. The unhurried Honda appeared rock steady while my mount was squirming about under late braking into corners, tail wagging under hard acceleration on the exits, and wallowing over undulations unless the drive was hard on.

After a couple of laps we swapped bikes and the difference was amazing. Instead of sitting in the huge Mammut, I was astride as normal. Unsurprisingly, the steering and handling were the opposite of the Mammut; heavier at low speeds and lighter at high. The Honda inspired more confidence in cornering, especially at 90mph provided the power was kept on. Changing lines unexpectedly could cause weaving but there was none of the Mammut's head-shaking over bumps or ripples. The CB750's ground clearance allowed more extreme angles of lean before anything grounded. Top speed of about 120mph was the same for each.

Two months later at a production-machine race in Sweden I had the opportunity to see how the Honda compared with best of British production race machinery, an extensively-tuned 650cc Triumph Bonneville entered by Boyer of Bromley that I was riding. Local ace Bo Granath was riding a bog-standard CB750, the first sold in Sweden. Just a second separated our fastest laps on the Anderstorp GP circuit before I finished sixth in front of the Honda.

"LAUNCHING THE FIRST SUPERBIKE WAS AS PHENOMENAL AN ACHIEVEMENT AS WINNING ALL FIVE WORLD ROAD RACING CHAMPIONSHIP CLASSES IN 1966."



A factory three-quarter view of Honda's CB750 K1.

back-to-back against a Triumph Trident in the deserts of California in December 1968.

Yet while this bike, or one like it, was also tested by *Cycle Guide* magazine in the US in March 1969, later, so-called Late-pre-production, versions of the CB750 were being prepared for showing to US dealers in January 1969 and two months later in the UK.

Four Late-pre-production machines are thought to have been made, says Steve Shaw, and given engine numbers 2110 to 2113. One of these, 2110, is the celebrated gold-finished 'Brighton bike' earlier tested by the press at Brands Hatch and displayed alongside another at the Brighton show. It was sold to the Earl of Denbigh, then the chief of the Motor Cycle Industry organisation in the UK, well in advance of the production bikes that reached UK dealers early in 1970.

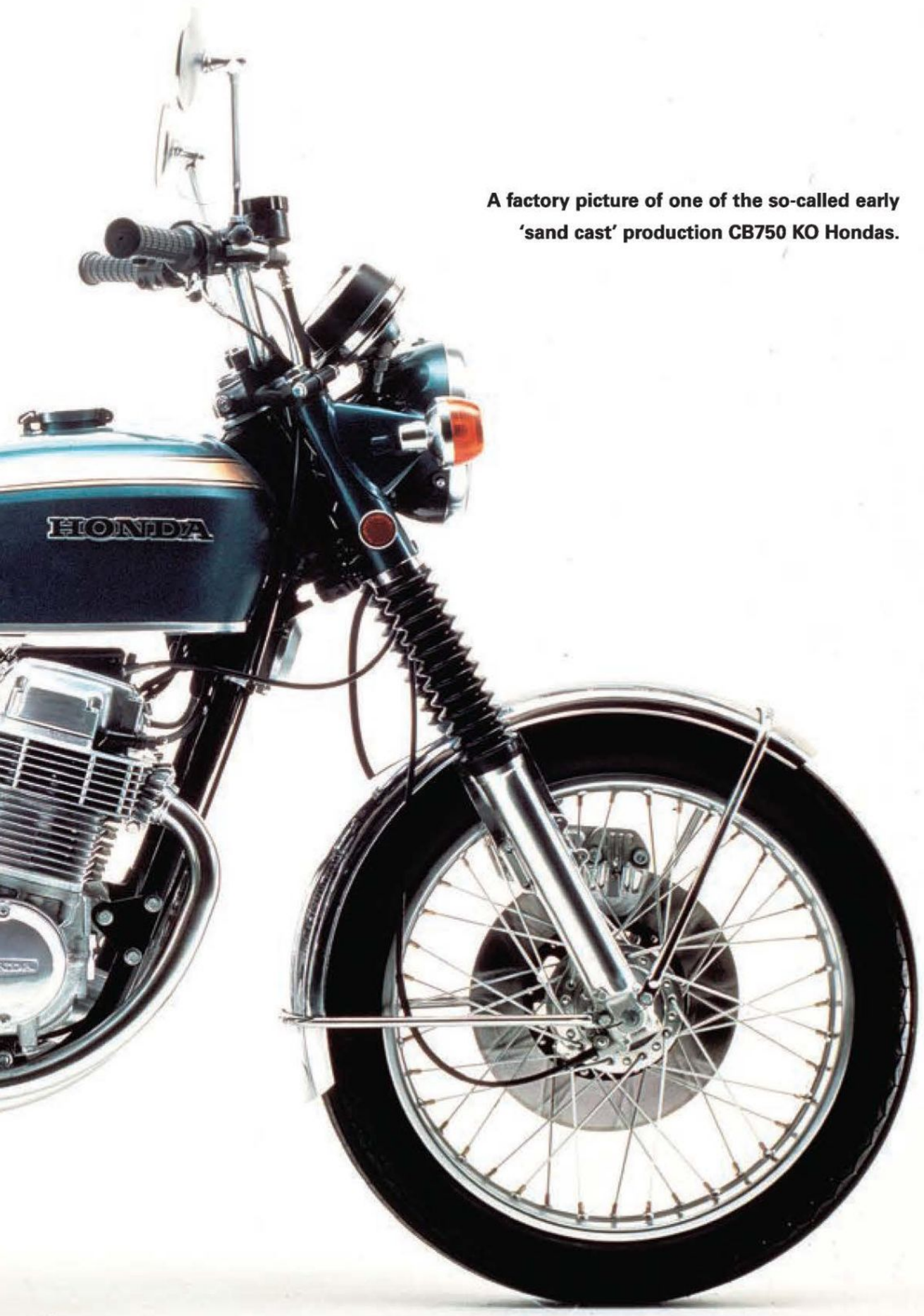
The Brighton bikes had production-style carburettors with four cables, but many non-production items, the most obvious of which were the flatter seat profile, the shape of the alternator cover, the fork's mudguard mounting stays, the turn signal lenses and the styling of the front brake hydraulic pipe work. Two, 2110 and 2113, are known to still exist.

CB750 enthusiasts will no doubt contest the detailing for years to come, but it is clear that Honda was working fast to get the bike into production before other factories, and it was inevitable that with a range of suppliers providing parts there would be variations.

Steve Shaw warns restorers that the literature of the time, such as sales leaflets and service manuals, is unlikely to offer a faithful guide to how an individual bike should look. "Honda was not only under tremendous pressure but also in a big rush to produce an actual, running multi-cylinder motorcycle as well as deliver a production machine to the retail dealers," he says.

"For Honda to have actual pictures of an existing four-cylinder motorcycle in prototype and pre-production forms was far more important than providing pictures of the actual bike delivered for retail sale."

Even after production had started at Honda's Saitama factory in Japan to meet a delivery target of June 1969, parts were regularly being changed. These bikes are identified by their engine and frame numbers starting at CB750-1000001, but the main clues to identifying the very earliest machines are the silver brake caliper with bolts on the back, painted headlamp mounts and air-cleaner cases, triangular side-panel badges, a



A factory picture of one of the so-called early 'sand cast' production CB750 KO Hondas.

HONDA CB750 SPECIFICATION

MODEL	Honda CB750
ENGINE	Air-cooled four
CAPACITY	736cc (61 x 63mm)
VALVE OPERATION	Single overhead camshaft
COMPRESSION RATIO	9.0 to 1
LUBRICATION	Dry sump, 3.5 l oil tank
IGNITION	Mechanical points, inductive
CARBURATION	Four 28mm Keihin
PEAK POWER	67 ps at 8,000 rpm
PEAK TORQUE	6.1 kgm at 7,000 rpm
PRIMARY DRIVE	Twin roller chains
PRIMARY RATIO	1.708:1
CLUTCH	Wet multiplate
GEARBOX	Five speed
INTERNAL RATIOS	2.500; 1.708; 1.333; 1.097; 0.939 to 1
FINAL DRIVE	Gear and 5/8 x 3/8in chain
FINAL DRIVE RATIO	1.167:1 & 2.667:1 (18/48t)
OVERALL RATIOS	13.29, 9.08, 7.09, 5.83 & 4.99 to 1
FRAME	Duplex tubular steel cradle
FRONT SUSPENSION	Telescopic fork
REAR SUSPENSION	Swing arm, twin shock, adjustable preload.
FRONT WHEEL	Laced spoke, steel rim
REAR WHEEL	Laced spoke, steel rim
FRONT TYRE	325 x H19
REAR TYRE	400 x H18
FRONT BRAKE	Single 300mm disc, floating caliper
REAR BRAKE	180mm drum
ELECTRICAL SYSTEM	Alternator 190W, 60/55W quartz headlamp, starter motor
BATTERY	12V-14Ah
FUEL TANK	19 litres
WHEELBASE	1,455mm (57.3in)
SEAT HEIGHT	805mm (31.7in)
CASTOR ANGLE	63.0 deg
TRAIL	95mm (3.74in)
WEIGHT	232kg (510 lb) with a gallon of fuel
PERFORMANCE	
TOP SPEED	124mph (claimed)
STANDING QUARTER MILE	12.4 secs (claimed)
SPEEDS IN GEARS	45, 66, 85, 103 & 120mph at 8,000rpm.

specific type of silencer, an unfinned oil-filter case and – most important of all – the early type of crankcases with a rougher finish resulting from the use of gravity casting, the so-called 'sand-cast' models.

Early changes were numerous (see chart with a typical selection taken from Honda's Product Notices) and almost weekly as improvements were included on the evolving production line. But to speed up output the crankcases from late in 1969 were made with pressure die-casting giving a smoother finish. Honda told the network from 23 December 1969 that the change was effective from engine number 1007415. At the same time the clutch cover was changed to use 10 rather than nine mounting screws. And so the beginnings of the exclusive Sand Cast Only Club were established (see www.cb750sandcastonly.com).

Within this early period – which also included Dick Mann winning the 1970 Daytona 200 with one of four factory-prepared racers – the production bikes are variously described as CB750 or CB750K0, but some say that just 121 machines were made incorporating some shared transitional features.

All machines to K1 had silver calipers, badges and silencers, painted headlamp mounts and small side reflectors, but the sand cast crankcases and unfinned oil filter case were features of the earlier ones only.

Whatever, by August 1970 the pace of change hotted up and with CB750-1044650 the CB750K1 was introduced along with another raft of modifications such as the introduction of the linkage for the carburettors making adjustments easier, a black brake caliper, slimmer side panels with two emblems, a 750Four above a Honda Wing diamond.

Further changes which would be carried over to following models made up to 1978 were introduced with the CB750K2 in 1972. Starting with engine number 2000001, these are identified by the chrome headlamp mounts, black headlamp shell and another revision to the '750 Four' side-panel badges. More detailed information can be found on the SOHC4 web site (www.sohc4.net) which should be on any CB750 fan's favourites.

Honda had not just won the race to get a four-cylinder machine designed and built for public view, it had managed in the space of around 18 months to set up production and get bikes to dealers. Launching the first Superbike was as phenomenal an achievement as winning all five world road racing championship classes in 1966.

Mick Woollett, who became editor of *Motor Cycle* in 1976, rides one of the first pre-production Honda CB750 Fours in Europe at Brands Hatch in March 1969.


YAMAHA
YPVS

MIRA FILES

The day the music died

Two-stroke fans rue the day when the last Yamaha RD350 YPVS was produced. John Nutting recalls testing the bike in the 80s.

Originally printed in the June 2005 issue of *Classic Motorcycle Mechanics*

For water-cooled Yamaha twin fans – otherwise known as Elsie addicts – the day the music died was, almost a decade ago, in January 1996.

That was when the final RD350R – last of the power-valve models – rolled off Yamaha's production line in Brazil. Production had been transferred there from Japan in 1991.

Chased off by increasingly tough emissions regulations, the two-stroke engine – once the only type offered by Yamaha – was becoming history. Getting high on the intoxicating mixture of peaky power bands and aromatic exhaust fumes would be the preserve of a declining tribe of enthusiasts. It was the end of an era.

The fans had been served with two-strokes of rising potency through the 60s and 70s, but the bike that provided the biggest kick was the RD350LC in 1980. It became a legend in its own lunchtime, fuelled by the antics of young and crazy racers competing in the Yamaha Pro-Am series which was sponsored by Wrangler jeans and Which Bike? magazine, where I was editor at the time.

Yamaha's European product development team, led by Paul Butler, had been right on target with the LC, and stretched the idea of satisfying a need for a racing-style road bike with the power-valve RD350 in 1983.

With a better and lighter chassis, better styling and above all much more power, the YPVS again made most performance bikes of the time feel tame, even big bikes. It was the combination of 59bhp in a bike weighing 357lb tanked up that turned the YPVS into one of the hottest bikes on the block.

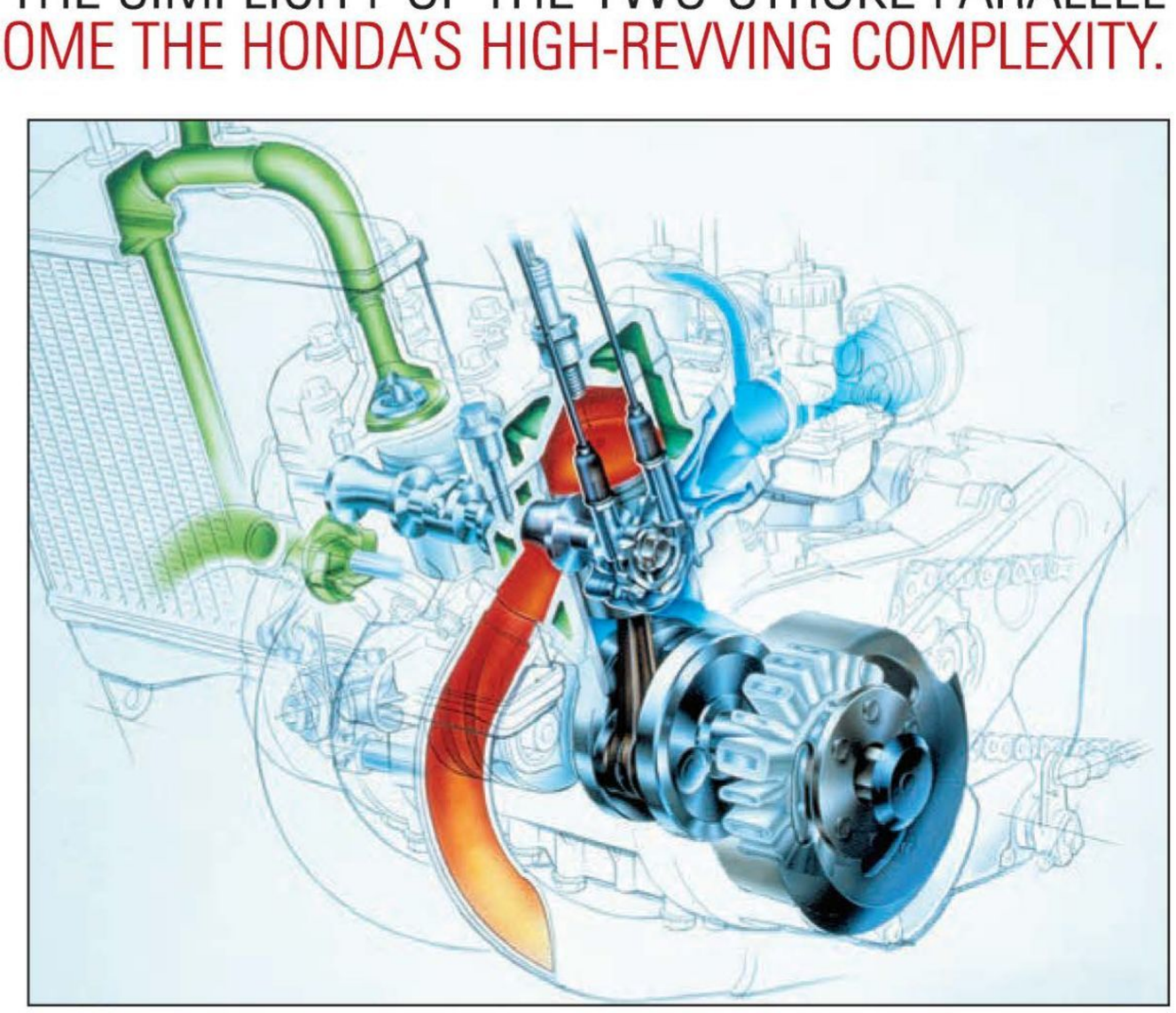
And it looked the part with a red frame, white bodywork and liberal use of eggshell black for the hardware. Technical developments in the 347cc engine included the electronic control of the rotary exhaust valves that broadened the power delivery, a feature that had been first used on Yamaha's road racers and motocross bikes five years earlier, capacitor discharge ignition, bigger reed valves and a tougher six-speed gearbox. The chassis was even more improved with

IT WAS THE CLASSIC TWO-STROKE VERSUS FOUR-STROKE SHOOTOUT, AND THOUGH SOME IN THE WHICH BIKE? CAMP THOUGHT IT WAS LIKE COMPARING CHALK AND CHEESE, THE TEST ILLUSTRATED HOW THE SIMPLICITY OF THE TWO-STROKE PARALLEL TWIN COULD OVERCOME THE HONDA'S HIGH-REVVING COMPLEXITY.

350 power-valve history

Dates	Model name	Model code	From engine/frame nos
1983	RD350LCII	31K	31K-000101
1985	RD350F	57V	31K-053101
1985	RD350N	1JF	31K-077101
1986-88	RD350FII	1WT	1WT-000101
1986	RD350NII	1UA	1WT-005101
1988-91	RD350FII	3DH1	1WT-015101
1992-95	RD350R	4CE6	4CE-0000101 (eng)
			9C64CE00*0000101 (frame)

1982	RD350YPVS launched at Paris Show in October
1983	RD350YPVS on sale in UK
1984	RZ350 on sale in US equipped with catalytic converter
1985	RD350N (naked) and RD350F (faired) launched in spring toreplace YPVS
1986	RD350NII and RD350FII launched with more powerful engine, and restyled wheels and bodywork
1987	RD350NII discontinued
1988	RD350R with new fairing starts production in Brazil.
1991	Production of RD350FII discontinued at end of year
1993	RD350R launched in UK
1996	Production of RD350R stops



a stiffer front fork, a better-braced frame and an adjustable rear shock that controlled the stronger rear fork through a linkage. Restyled alloy 18in wheels came with wider rims and wider tubeless Yokohama tyres.

At Which Bike? magazine we'd been able to explore the potential of an RD250LC twin with a number of test bikes and a machine that had been provided by the importer Mitsui on long-term loan (see page 125). Using the MIRA proving ground's 1000-yard timing straight we'd found that a stock 250LC had a maximum speed of slightly less than 99mph.

But the original RD350LC was not as fast as its claimed power (47bhp versus the 250's 35.5bhp) would suggest. One 350LC tested in October 1982 clocked a two-way mean top speed of 107.1mph and a standing quarter-mile time of 13.82 seconds, with a terminal speed of 92.03mph. Tuning and modifications would be well rewarded though, and a 347cc test bike tweaked by Stan Stephens (barrels, heads, carbs, air filter, exhaust pipes were all changed) once clocked a best of more than 132mph.

While seat-of-the-pants impressions of the YPVS at its launch in Japan early in 1983 suggested it was quicker than the LC, the real measure of the bike was shown when I took it to the MIRA test strip in May 1983 along with Honda's vee-four VF400F (see Classic Motorcycle Mechanics, January 2005). It was the classic two-stroke versus four-stroke shootout, and though some in the Which Bike? camp thought it was like comparing chalk and cheese, the test illustrated how the simplicity of the two-stroke parallel twin could overcome the Honda's high-revving complexity.

On the road both bikes offered sublime handling for the time, though the Yamaha invited its rider to explore the limits of its tyres and its sheer unwieldiness meant you could find the bike weaving at high speed. Both would cruise smoothly at 100mph, the Honda revving at 10,000rpm though you'd only know this from the rev meter: unlike in-line fours the VF400F displayed the unhurried feel of all vee engines. In contrast the Yamaha was revving at just 7500rpm, nicely into its power band that started at 4500, but the rider was insulated from any vibration by rubber mounts for the engine.

Quick and refined, the Honda could be easily stuffed out of corners by the Yamaha's snappy response. In every way that counted, the Yamaha held all the cards. But by how much? And how much quicker than the old 350LC would it be?

THE YPVS DERIVATIVES

With a small handlebar fairing enclosing the instrument cluster, the first YPVS RD350 Yamaha in 1983 provided nimble handling, but was criticised for becoming wayward at the much higher speeds it was capable of compared with the original LC.

While the earlier RD350LC twins would top out before reaching 110mph, the power-valve models would accelerate harder to 120mph, but would often develop a weave above the ton. This was widely attributed to the inertia created by the weight of the instruments and the aerodynamics of the small handlebar fairing, though it didn't bother racers who used the bike in the production class who could make subtle changes to the steering geometry to give more stability.

In the US riders weren't offered the RD350LC, but in 1984 Yamaha included in its range the RZ350, which came in revered yellow-and-black works livery. To meet Californian emission requirements the model was equipped with exhaust catalysers and an air bleed into the front of the exhaust pipe. To ensure that the carburation was less prone to variation the carburettors were different from their European counterparts and featured an opening linkage enclosed with the bodies.

Elsewhere, an RZ250 model was also offered but not in the UK, which retained the RD250LC version.

For the 1985 European model year, two versions were offered with a tad more peak power, the RD350F with a racing-style full fairing in which the instruments were mounted, relieving the front fork of their weight, and the RD350N, with no fairing at all.

To improve the stability of the front end, the mudguard included a stiff brace that connected the fork legs. At the same time the rear fork was modified with a more substantial wheel spindle that was clamped by sliding adjustment blocks inside the rectangular arms. Because these were wider, the exhaust pipes were dented to keep them tucked in. But while high-speed handling of the F, despite the extra weight, was improved the N's roadholding deteriorated, and was not helped by the more racy riding stance provided by the narrower, downswept handlebars.

A year later in 1986, both models underwent a more substantial revision and called the RD350F2 and RD350N2 respectively. Styling of the tank, seat and side panels reflected that used on the later TZR250, while power was boosted to a claimed 62bhp by the use of exhaust pipes with tailpipe silencers. The brakes and wheels were also revised. But even though the carbs boasted fashionable power jets to enhance top-end power, the engine was more restricted, failing to rev to more than 8500rpm.

By 1988, it was thought that the YPVS was reaching the end of its model life when the 350N2 was discontinued, but production started at Yamaha's factory in Brazil of the low-cost RD350R, a new faired model with twin headlamps and an even softer engine.

Production of the RD350F2 stopped in 1990 and just when it was thought the YPVS was history the RD350R was imported into Europe from 1991, continuing until 1995.

RD350 YPVS 1983

model	Yamaha RD350LC YPVS
engine	Liquid-cooled two-stroke parallel twin
capacity	347cc (64 x 54mm)
valve operation	Reed-valve inlet, variable exhaust timing
compression ratio	6.0 to 1 (static)
lubrication	Oil injection
ignition	Capacitor discharge
carburation	Two 26mm Mikuni VM
peak power	59 bhp @ 9000rpm
peak torque	34.2 lb-ft @ 8500rpm
primary drive	Gear
primary ratio	66/23 (2.87 to 1)
clutch	Wet multiplate
gearbox	Six speed
internal ratios	2.571, 1.778, 1.318, 1.083, 0.962 & 0.889 to 1.
final drive	525 O-ring type
final drive ratio	39/17 (2.294 to 1)
overall ratios	16.9, 11.7, 8.68, 7.11, 6.33 & 5.85 to 1.
frame	Duplex tubular steel cradle type
front suspension	Air-assisted telescopic fork
rear suspension	Swing arm, single shock, adjustable preload.
front wheel	Cast alloy three spoke, 2.15 x 18
rear wheel	Cast alloy three spoke, 2.50 x 18
front tyre	Yokohama 90/90-18-51H tubeless
rear tyre	Yokohama 110/80-18-56H tubeless
front brake	Dual 270mm discs
rear brake	Single 270mm disc
electrical system	Alternator 190W, 60/55W quartz headlamp
battery	12v 5.5Ah
fuel tank	20 litres, unleaded, reserve 2 litres
DIMENSIONS	
wheelbase	1385mm (54.5 in)
seat height	810mm (31.9in)
castor angle	64-deg
trail	96mm
claimed dry weight	143kg (319lb)

further reading

Yamaha RD350 1980-1996, written and published by Rodger Taylor. ISBN 0-9547541-0-7, Available online for £14.99 plus p&p at www.bike-books.com

Yamaha RD350LC/YPVS, by Phil West, one of the Haynes Great Bikes Series. Hardback, 259 x 195mm, 144 pages, 140 mainly colour illustrations. ISBN 1 85960 950 3. £19.99.

Yamaha RD350 YPVS Twins (83-95) manual, Haynes Publishing. ISBN 1 85010 879 X. £14.99.

technical advice and tuning

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Tel 01732 760337. Fax 01732 760339.

websites

www.lcclub.info

www.yamaha-rd.com

First up we compared the top speeds using a conventional riding position. With two opposing runs at 108.15mph and 105.05mph for a mean of 106.6mph, the Yamaha was slightly faster than the Honda which recorded 107.04mph and 103.24mph for a mean of 105.14mph. First round to the YPVS.

Experience had shown that the Yamaha could rev to 10,000rpm through the gears and on its higher gearing (with 17/39 final drive sprockets compared with the 350LC's 16/39) might reach 125mph.

BETTER STILL FOR ROAD USE, THE YPVS WASN'T AS THIRSTY WITH THE FUEL AS THE 350LC.

So, in racing leathers and chinning the tank I nailed the twistgrip to the stop, the first run west on the strip clocking 120.54mph. Subsequent runs clocked 119.70mph and 120.49mph. Going east and very slightly uphill the figures were 117.64mph and... 117.64mph, for a two way mean of 119.1mph at 9500rpm in top, around 3mph up on the Honda.

These figures confirmed the Yamaha's peak power was higher than the Honda's, but the difference in weight – at 357lb with a gallon of fuel, the Yamaha was some 60lb lighter than the Honda – should show up even more in the acceleration tests.

Of the east and west runs on the YPVS, the best were 13.24s at 98.54mph and 13.07s at 100.54mph (a two-way mean of 13.16s at 99.54mph), around half a

performance data

model	Yamaha RD350LC	Yamaha RD350 VPVS
date of test	18 October 1982	31 May 1983
reg no	na	na
mean speed prone (mph)	107.10	119.10
best one-way (mph)	110.00	120.54
mean normally seated (mph)	97.88	106.60
standing quarter-mile (mean, secs/mph)	13.83/92.03	13.16/99.54
speedo accuracy, actual mph at indicated		
30mph	29.9	28.7
50mph	49.4	45.3
70mph	69.0	64.8
test weight (1gal fuel)	370lb	357lb
overall fuel consumption	40.0mpg	45.3mpg
variation of consumption	na	40.9-49.9mpg
range	160 miles	160-200 miles

All figures compiled at Motor Industry Research Association's proving ground, Nuneaton, Warwickshire.

second and 3mph up on the Honda, but in a different league from any other 350cc or 400cc machine of the time, and way ahead of the old 350LC.

Better still for road use, the YPVS wasn't as thirsty with the fuel as the 350LC. In normal use, consumption varied between 40 and 50mpg, giving a range of 180 miles or more, the only downside being that you'd need to replenish the two-stroke oil tank under the seat occasionally, using not much more oil than would be required for an oil change every 2000 miles on the Honda.

For anyone contemplating a bike for fun, it was no contest, the Yamaha won hands down, and particularly so because at £1695 it was also £200 cheaper than the Honda.

Sports bike riders in the 21st century might think their 600cc fours are the epitome of performance. Imagine what a 500cc two-stroke might offer with the same 20 years of development in power delivery and emissions reductions.

TECHNICAL DESCRIPTION

Although apparently a seamless development of the original RD350LC, Yamaha's power-valve RD350 YPVS introduced three model years later in 1983 was completely new: engine, frame, styling, wheels and brakes owed nothing to the earlier model apart from having the designer's single-minded objective of providing the rider with undiluted thrills.

The perimeter-style tubular duplex frame was revised to give more room for the air filter and intake plumbing, enabling better breathing, while the rear suspension's single shock was also tucked out of the way, controlling the movement of the rectangular-section swing arm through a linkage with plain bushes.

For better stability, the front fork used larger diameter legs (35mm rather than 32mm) with air pressure assist and revised damping valves and for stronger stopping power the twin front discs were slotted, and augmented by a similar, if too potent, rear disc.

All of which was used to harness an engine which from the same 347cc capacity pumped out 25 per cent more power at the top end, 59bhp at 9000rpm compared with the LC's 47bhp at 8500rpm. It was phenomenal. Similar 600cc four-stroke fours only reached such levels of specific power – almost 170bhp per litre – more than a dozen years later.

But it wasn't just the use of the clever power-valve that made the YPVS engine so potent. In designing the new engine the opportunity was taken to beef up a number of components to improve reliability and change the layout of the cylinders.

Although still a simple liquid-cooled parallel twin with pistons at 180-degrees turning a four-bearing pressed-up crankshaft, and as such following the same lines of the TZ racing engines, the YPVS was still made with road use in mind.

So unlike the TZ's single cylinder block the YPVS used separate cylinders, following LC practice. The LC's four through-bolts for each pot, which cramped the transfer porting, especially on the inner sides, were changed so that the YPVS's cylinders bolted to the crankcases and the single head casting used five bolts for each of the cylinders. This allowed the transfer ports more room to loop around the cylinders with less restriction, aiding filling efficiency.

Yamaha had been developing the use of the power-valve since 1974, In 1977 the four-cylinder YZR500 grand prix bike raced by Kenny Roberts was fitted with them. He won the world title the next year.

Yamaha engineer Taichi Ito later told Australian MCN: "Development work had already been done for mounting the system on single-cylinder motocrossers, but this was the first time for a four-cylinder machine, and it brought a number of unique problems, like how to attach the cylinder to the crankcase and whether to make the four YPVS valves jointly operable."

A two-stroke engine design is a host of compromises, one of which was that in the quest for higher power, the revs would have to rise along with a narrowing band in which the engine would run effectively.

Huge power increases had been extracted by the refinement of expansion chamber exhaust systems ever since MZ had first effectively used them in the 60s. The idea was that the expanding diameter of the front half of exhaust pipe would create a sonic wave that would reduce the pressure in the exhaust port just as it was opening as the piston was falling, pulling burnt mixture from the combustion chamber and fresh charge through the transfer ports. The tapered section would then soon after reflect another negative sonic wave that would raise the pressure in the exhaust port just as the piston was rising from bottom dead centre, trapping the unburnt charge and raising volumetric efficiency.

High power outputs also called for the use of long exhaust port timing, but the power would drop away dramatically outside the rev bands in which the system was designed to resonate. What Yamaha's engineers devised was a valve that shortened the exhaust port timing, the corollary of which was a higher effective compression ratio.

The YPVS used a derivative of the more sophisticated electronically-controlled system used on the road racers, with a small servo motor connected by two cables to the power-valve's pulleys. At low revs the valve partially closed off the port (it was close enough to the cylinder bore to have an effect) but at around 4000rpm the valve would start to open so that the full potential of the engine was available.

Yamaha's engineers could have stuck with the LC's peak power of 47bhp and made the engine more potent at low revs, but instead went for broke and pitched the peak at 59bhp with a nice leap in the response at 4500rpm.

As executed on the YPVS, the power-valve called for regular fettling because the valve on each cylinder would eventually become clogged by carbon build-up, and the linkage between the cylinders, exposed to road dirt from the front wheel, could seize. Eventually the offside valve could seize, breaking the linkage, and also rendering the servo motor, which was programmed to rotate the valves to clean them after the ignition was switched on, useless.

Dimensionally the YPVS was almost identical to the LC, with the same bore and stroke of 64 x 54mm and the same pitch between the centre lines of the pots. To improve the reliability of the crank, the big ends were each 1mm wider, space for which was provided by a narrower labyrinth seal on the centre of the crank.

The Mikuni VM carburettors were much better on the YPVS, although of the same nominal 26mm bore diameter; breathing was improved through the bigger air filter chamber and bigger reed valve blocks, which were the same size as those on the TZ750 racer.

Other changes included an improved capacitor-discharge ignition system (though not with the timing changing with load as was reported at the time), larger gearbox shafts (with the same six internal ratios) and an external clutch operation mechanism (that usefully provided more room for a larger gearbox sprocket).

Honda CB400F

Honda's CB400F four of 1975 was a ground-breaking machine, a little bike with a big heart that took to the race track with glee as John Nutting can personally testify.

WHEN it comes to discussing Honda's CB400F, the iconic four cylinder sports bike made from 1975 to 1977, the world is divided into two opposed groups.

There are those who dismiss the machine as an overrated and gutless aberration that was markedly inferior to its larger siblings.

Others admire it as a daring design that brought multi-cylinder four stroke performance to the middleweight sector. They regard the CB400F as a turning point that tapped a market for riders who wanted the reliability of Japanese machines in a more rakish and sporty package.

I confess to belonging to the latter camp. But the reasons for my allegiance are that, having performance tested the CB400F and machines that preceded and followed it in Honda's development, it stood out as a ground breaking design that set the tone for other factories to follow.

It was only marginally slower than the CB500 Four launched three years earlier and, more importantly, it steered and handled almost intuitively, a first for Honda, if not the Japanese factories in general. That made the CB400F a prime candidate for production racing, where its potential for tuning and development could be exploited.

Its styling - with a long fuel tank, a sporty seat, a four-into-one exhaust system and a distinguishing graphic simplicity - was ground breaking. But the experience of riding the machine was also completely new. Yes, you had to rev it, but with a six-speed gearbox to play with that was no great inconvenience. Indeed, it added to the fun. And that was the key.

True, that fun came at a price and it was likely that Honda was hardly making a profit on a retail price of £699 when it was launched in the UK. Or even at £809 in its final model year in 1977.

That's when the accountants took over again and Honda introduced the five-speed six-valve CB400T twin, a slightly functionally superior machine utterly devoid of personality that was further diluted with the 'Eurostyled' CB400N.

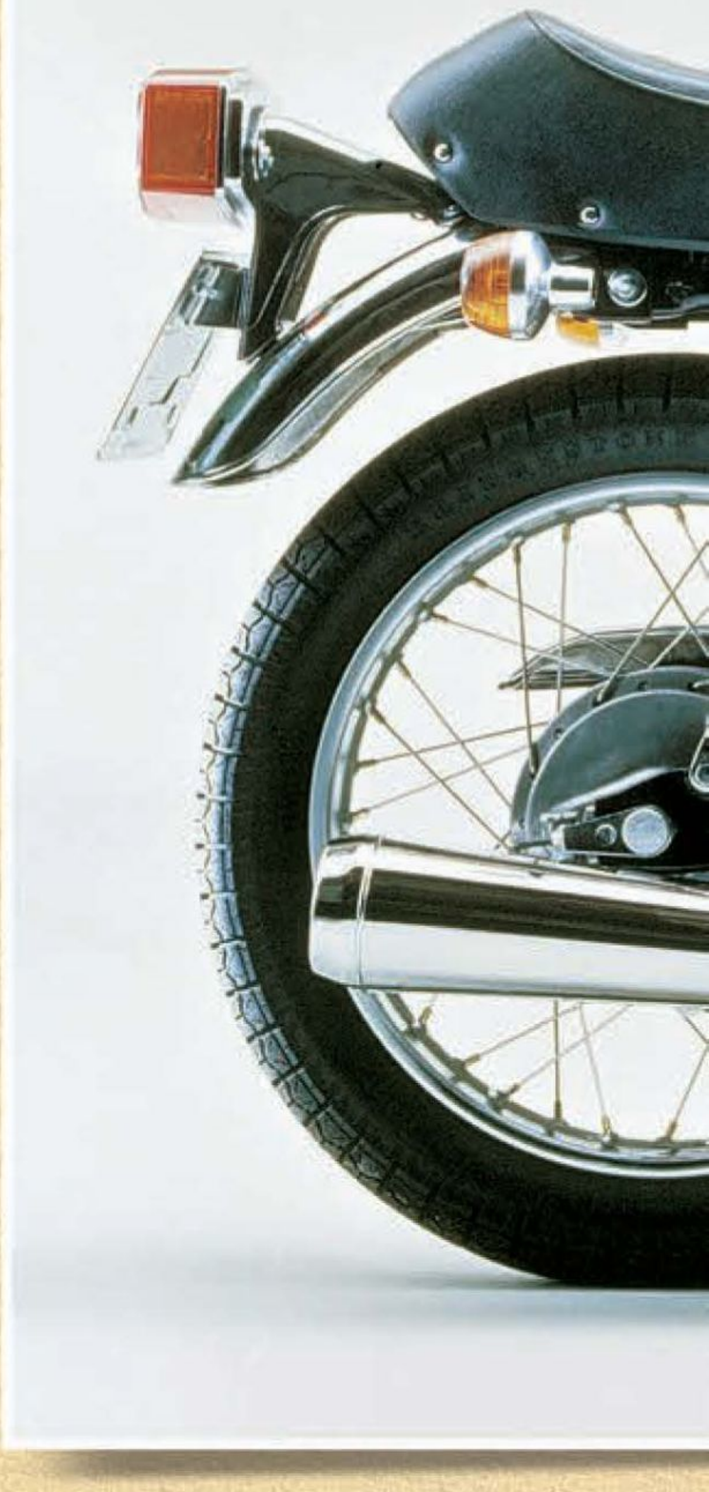
Measured by today's standards, it is easy to criticise the CB400F's modest performance, weedy brakes and harsh suspension. Even easier to mock a neglected machine's rotting chrome, iffy ignition and self-destructing camchain tensioner. But once past its prime almost every model of that period had its weaknesses. Especially if it was not serviced by the book.

More than 30 years ago, the CB400F was a signal that Honda wanted to break out of the mould, and in more ways than one. Flushed by the world's response to the four cylinder CB750 in 1969, Japan's biggest automotive manufacturer launched the CB500 Four in 1971 and the CB350 Four (which never appeared in the UK) a year later.

But after its engineers had exerted themselves on the new fours, Honda began concentrating more on its car range and it is arguable that it wasn't keeping its eye on the two-wheeled ball, as shown when it replaced the CB250K4 and CB350K4 twins with the awful G5 versions.

They looked tired and were

Factory picture of the original 1975 F1.



Unmistakable as Honda's 400/4 with that swooping exhaust system. This is the F2 model.

THE MIRA FILES...THE MIRA FILES..

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even more tiring to ride. Meanwhile factories like Kawasaki were introducing blockbusters such as the Z1. Honda had to make a dramatic move.

IT was at the Cologne Show in Germany late in 1974 that it happened, and on two fronts. Honda launched the flat-four Gold Wing tourer alongside the 'Super Sports' CB400F. Both machines were stunning: the Wing for its immensity (few in Europe really understood that it was the Genesis of the classic US touring machine) and the style of the 400, which was based on the 350 four but with a new chassis, cylinder block, head and gearbox.

With a claimed 37bhp at 8500rpm and a weight of 392 pounds, the CB400F was expected to be the four stroke equivalent of Yamaha's 350cc two stroke twin: a head-banging scratcher's delight.

But when in the following February I collected the Honda test bike from dealer Tippets in Surbiton, south London, my first impressions were anything but.

'Gushing' barely describes my comments in the subsequent road test in *Motor Cycle*, the weekly paper: "With looks that scream 'racer' from every sparkling highlight on those distinctive four-into-one exhaust pipes to the scarlet works-styled tank and mini side covers and folding setback footrests, it feels so unarguably right it's almost unbelievable.

"Smooth as a turbine and quiet as a car, the CB400F offers nimble, secure handling whether in heavy traffic or cruising country roads. It is also very compact and light for a four cylinder machine."

The CB400F was both a model of refinement - as indeed were the CB350 and CB500 fours. Hardly what a two stroke fiend might find appealing but the revelation was that it steered and handled almost perfectly.

Until then Hondas had been afflicted not just by poor suspension but with a propensity to fall into corners, requiring conscious effort from the rider to maintain a line. Many owners would get used to this and regard it as the norm, but to anyone who had the benefit of being able to sample a wide range of models found it annoying. With the compact CB400F it was suddenly like being freed from a shackle.

The performance took a little longer to get used to; about half an hour. We're accustomed these days to fours that rev to 16,000 or more, but in 1975 a machine that could buzz to 10,000 through the gears demanded a new style of riding.

But I quickly acclimatised to it, and the thrill of winding it up in the knowledge that you wouldn't rattle the neighbours.

SOME say that the CB400F's performance was a disappointment. I can't understand why. On a cold February day at MIRA's 1000-yard test strip, the bike clocked a two-way mean top speed of just over 104mph, only one mph down on the CB500 with a best one-way speed of just over 105mph, revving to more than 10,000 in top gear, way over the red line.

To get consistent top speeds I was flat on the tank and for safety considerations we removed the handlebar mirrors. The idea was to get the best possible speeds from the stock test bike.

Once again to quote the test report: "Its standing quarter time of 14.9secs (with a terminal speed of just over 87mph) was also just a fraction down on the 500. Economy was almost as good as the CB250 with a return of 55mpg at a steady 70; and even when run at 80-85mph, it never consumed any more than a gallon every 51 miles."

Tuners were quick to exploit the machine's potential, one of the first being Dixon Racing, the Yoshimura agent based in Surrey. David Dixon offered an over-bored version with a modified cylinder head and special exhaust system.

The stock capacity was taken up from 408cc (51 x 50mm) to 458cc with 54mm diameter pistons and to provide matching breathing capacity the eight valves were polished and contoured and a longer duration camshaft fitted.

At the same time the compression ratio was raised to 10 to 1 and a four-into-one pipe provided better extraction. The stock 20mm-choke Keihin carbs were retained but the main jets upped a size and the needles raised a notch. The standard coil and contact breaker ignition timing was advanced to provide a spark at 40 degrees BTDC.

The chassis was uprated too, with stiffer 85/115lb/inch S&W rear suspension units and front fork internals, and Borrani alloy rims. Gearing was raised a tooth at the gearbox to give 6800rpm at 70mph.

As such, David Dixon's CB460 was geared about right, as I might have expected from my predecessor at Motor Cycle, a man well versed in the subtleties of getting the best from test bikes at MIRA.

1978 'Harrier' version.

When I tested the bike in March 1976 the top speed was improved to a mean two-way of 107.77mph at 10,500rpm. But acceleration through the quarter mile was cut by almost a second with a time of 14 seconds and a terminal speed of 92.75mph.

By comparison, a stock Honda CB550F I tested at MIRA a week later clocked a mean top speed of 108.8mph with standing quarter mile times of 14.55 seconds and 90.46mph.

AT south London dealer Mocheck, boss Ian Tay was so excited by the CB400F that in 1976 he set up a production racing team with three modified machines that he called Faith, Hope and Charity. Backed by *Motor Cycle*, these were ridden by a number of top stars and many times punched above their weight in the 500cc production class, the Avon Roadrunner series and the TT.

John Ryan was chief mechanic for the Mocheck team. "They were only slightly modified," he recalls, "but one of the best results was Tony Rutter's outright win at Silverstone. In the Isle of Man he was clocked at 130mph at Brandish."

Changes included alloy wheel rims, an elongated fuel tank, racing seat, rearset footrests, clip-on handlebars and a tucked-in and gutted exhaust system.

For the TT, an extra machine was prepared and four riders entered: Phil Carpenter, Alex Ayres, Phil Mellor and Norman Tricoglus. But Tricoglus's machine suffered a puncture and following confusion in trying to repair it at the pit, the organisers excluded the bike, so Mocheck lost the team prize.

I joined in for a six-hour production race at Cadwell Park with Tricoglus and had a whale of a time diving under bigger machines.

I don't remember the result, only that we had a huge crash coming back from Louth on the Saturday night that left Norman's van looking more than a bit twisted. He had to wear a helmet on the way home to Northumberland because the windscreen was missing!

The following year in 1977 Mocheck followed up with a road-going version called the Harrier. This was also based on a 458cc Yoshimura conversion but

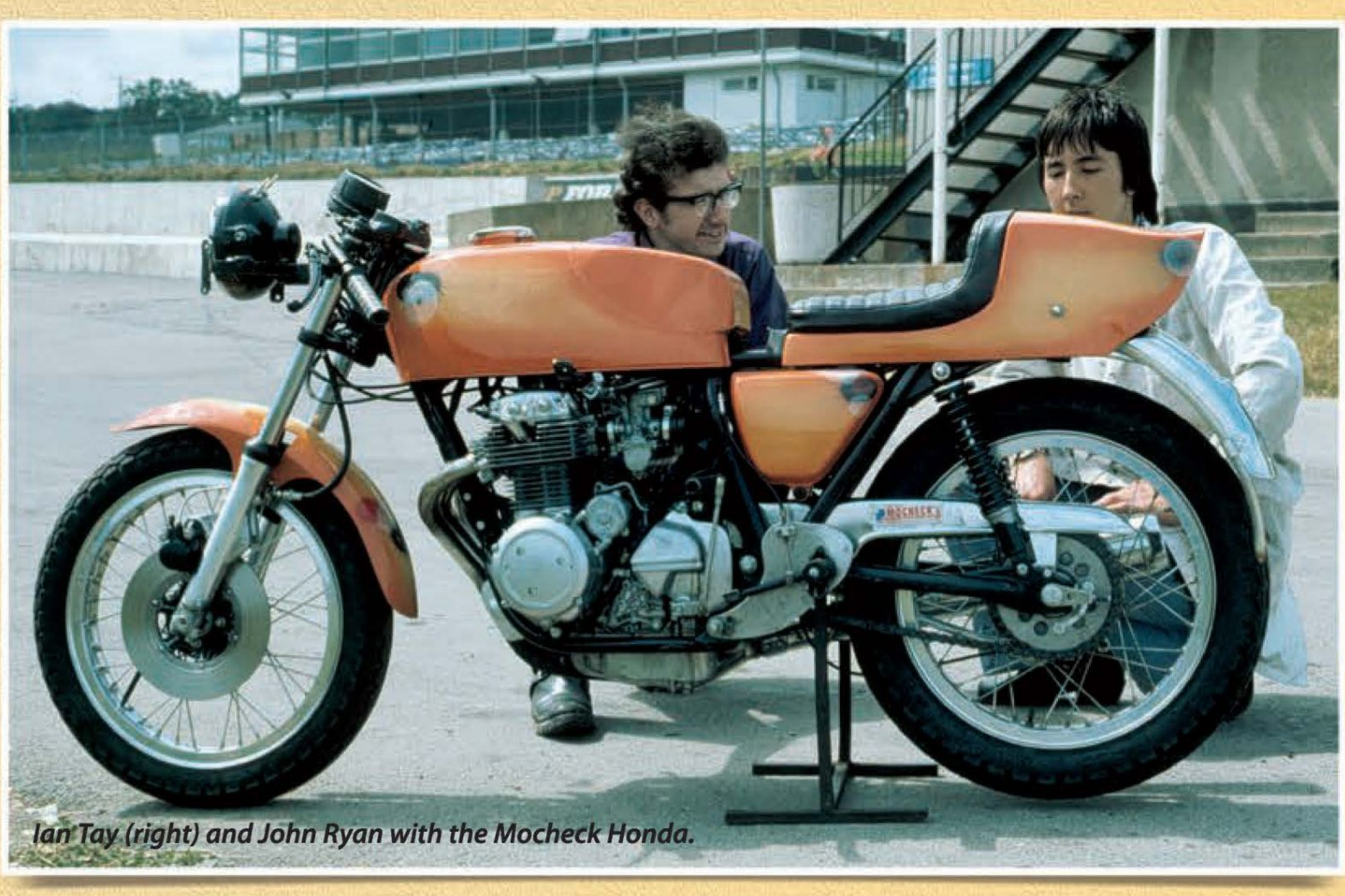
David Dixon-tuned 460cc version of 1976.

with a racing camshaft fitted along with a lightened crankshaft and improved porting for the head.

Electronic ignition from Lumenition provided more accurate sparks while a black Piper exhaust system reduced the back pressure. No power figures were quoted but the original 37bhp was likely to have been upped to at least 55bhp.

As with the Dixon machine, the chassis featured S&W rear shocks but the cast aluminium wheels, fitted with Avon Roadrunner tyres, were from CMA and finished off in white to match the rest of the machine.

At MIRA in December 1977 this was much more potent than the Dixon machine, pulling a mean 113.75 mean top speed with a best one way speed of 121mph. Acceleration was better too with a standing quarter mile time of 13.7



Ian Tay (right) and John Ryan with the Mocheck Honda.

Tony Rutter on the racing Mocheck Honda at Mallory Park in the Avon Roadrunner championship with modified exhaust.

seconds with a terminal speed of 95.47mph.

In this form the CB400F was a real giant killer. But for Honda, it was a cul-de-sac. US riders were unimpressed by the little bike with a big heart and that banged the final nail in its coffin. The CB400F failed to appear in the 1978 model range.

Our man Nutting joined the Mocheck team for a six hour race at Cadwell in 1976.

Honda CB400F

All figures compiled at Motor Industry Research Association's proving ground, Nuneaton, Warwickshire.

MODEL:	Honda CB400F	Dixon CB460F	Mocheck Harrier
DATE OF TEST:	27-2-75	11-3-76	12-77
REG NO:	JGC606N	na	GEB 35
CONDITIONS:	Misty, 40 deg F	Cold, cloudy	Cold, tail wind
MEAN TOP SPEED (MPH)	104.02	107.77	113.75
BEST ONE-WAY (MPH)	105.09	109.65	121.70
MEAN NORMALLY SEATED (MPH)	na	94.02	97.47
STANDING QUARTER-MILE:			
(MEAN SECS/MPH)	14.9/ 87.27	14.0/ 92.75	13.7/ 95.47
ACCELERATION (SECS/MPH)			
110YARDS	5.70/56.2	5.40/60.0	4.90/60.9
220YARDS	9.40/71.8	8.60/77.0	8.40/78.4
330YARDS	12.25/80.2	11.25/87.2	11.10/88.1
CONST. SPEED MPG@MPH			
30	101.0	89.6	78.4
50	83.2	70.4	60.8
70	54.4	48.0	46.4
BRAKING DISTANCE (FEET)			
(FROM 30MPH)	29ft	27.25ft	30ft
TTURNING CIRCLE (FT)	na	na	17.5ft
SPEEDO ACCURACY, ACTUAL MPH AT INDICATED:			
30	28.5	28.5	28.9
50	47.5	48.7	47.5
70	65.7	69.6	69.6
90	87.6	90.5	90.5
TEST WEIGHT (1GAL FUEL):	395lb	386lb	na
OVERALL TEST MPG	55.0	na	44.2

Cheap-to-make twins were the way ahead for Honda. Until their firebrand designers once again got the upper hand over the accountants in the early 1980s and the CBX400F (a smaller version of the CBX550F) and the more potent 398cc vee-four VF400F appeared.

The model changes

FEW changes were made to the UK model CB400F Honda in the three years from 1975 to 1977. In 1977 it appeared with frame mounted rear passenger foot pegs, stripes on the tank and italic text on the side panels, plus different indicator lenses.

The US models had higher handlebars, while the domestic model for the Japanese market had a 398cc capacity (from a shorter 48.8mm stroke) to bring it into a more attractive taxation bracket.

John tests the 1975 bike for Motor Cycle.

HONDA CB400F SPECIFICATION

MODEL:	CB400F
ENGINE:	Air-cooled four
CAPACITY:	408cc (51 x 50mm)
VALVE OPERATION:	Single overhead camshaft
COMPRESSION RATIO:	9.4 to 1
LUBRICATION:	Wet sump, capacity 3.5 litres.
IGNITION:	Mechanical points, inductive
CARBURATION:	Four 20mm Keihin
PRIMARY DRIVE:	Inverted-tooth chain and gear
PRIMARY RATIO:	na
CLUTCH:	Wet multiplate
GEARBOX:	Six speed
INTERNAL RATIOS:	1st, 2.733; 2nd, 1.800; 3rd, 1.375; 4th, 1.111; 5th, 0.965; 6th, 0.866.
FINAL DRIVE:	5/8 x 3/8in chain
FINAL DRIVE RATIO:	-/17
OVERALL RATIOS:	na
PEAK POWER:	37 ps at 8,500 rpm
PEAK TORQUE:	na
FRAME:	Semi Duplex tubular steel cradle
FRONT SUSPENSION:	Telescopic fork
REAR SUSPENSION:	Swing arm, twin shock, adjustable preload.
FRONT WHEEL:	Laced spoke, steel rim
REAR WHEEL:	Laced spoke, steel rim
FRONT TYRE:	300 x S18
REAR TYRE:	350 x S18
FRONT BRAKE:	Single 267mm disc, floating caliper
REAR BRAKE:	160mm drum
ELECTRICAL SYSTEM:	Alternator 156W, 60/55W quartz headlamp
BATTERY:	12V-12AH
FUEL TANK:	14 litres (3.08gal)
WHEELBASE:	1,355mm (53.5in)
SEAT HEIGHT:	790mm (31in)
CASTOR ANGLE:	63.5 deg
TRAIL:	85mm (3.35in)
CLAIMED DRY WEIGHT:	178kg (395 lb) with a gallon of fuel

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Kawasaki Z1, Z900, Z1000, Z1R

The incredible series of big Kawasaki fours lasted a decade and John Nutting was there at the birth of a dynasty that lives on today. No 'retro' can reproduce the unrefined feedback of the originals, he says.

I HAD the good fortune to test the performance of Kawasaki's original big fours at MIRA over a period of ten years, from their launch with the Z1 in 1973 through to the Z1000R, the 'green meanie' Eddie Lawson replica.

The figures chart a period during which Kawasaki established itself at the outset of the superbike era as the King of Speed, to temporarily relinquish its crown to Italian and Japanese competitors but to later regain the title, all with the same basic engine unit, a mighty aircooled four.

At the end of the sixties, Kawasaki was famed for its highly-strung two strokes. Of these, the 500cc Mach III triple was the most diabolical, pumping out a loosely harnessed 60 ps with a rending shriek that left its passing only matched by the clouds of blue smoke from the three low-slung pipes.

By 1968, factory designers were working on a potent but more civilised 750cc four stroke four but were stung when Honda launched its ground breaking CB750 later that year. Kawasaki didn't want to appear to bring out something similar, so its engineers went back to the drawing board and went one better.

In 1972 the news was out, and the machine, dubbed by Kawasaki's marketing department as 'New York Steak', was revealed as the Z1 featuring a 903cc engine that made the Honda seem puny in comparison. It was a unit that would establish the basic design of most motorcycle powerplants from that point on, using double overhead camshafts driven by a chain from the middle of the crankshaft, gear primary drive and a five speed gearbox.

First to get one of the pre-production models was Dutch importer Henk Vink. And as test rider for the weekly Motor Cycle, I was despatched to Amsterdam that Autumn to get the story on what the eagerly-awaited Kawasaki was like to ride.

Imagine the anticipation. I'd been in the job barely six months and the most potent bike I'd tested was Norton's 120mph 750cc Commando with the Combat engine. Honda didn't have a CB750 test bike on its fleet as a comparison. The Kawasaki loomed huge, both in its size, weight and performance.

John Nutting aboard the first Z1 tested in Britain in 1973. It tripped the MIRA timing lights at over 130mph.

1979 Z1000 Mk II - more power, better handling and brakes.

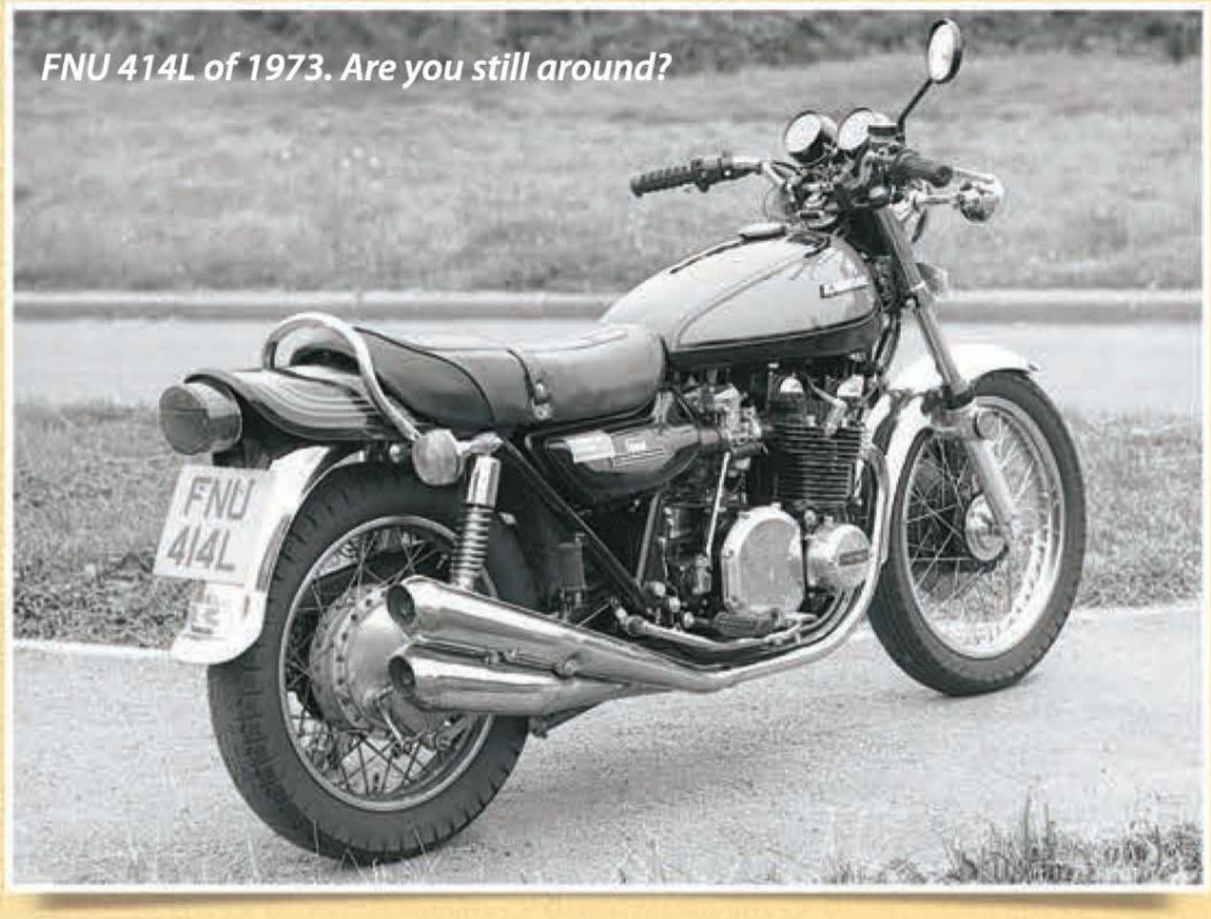
THE MIRA FILES...THE MIRA FILES..

But it turned out to be a model of refinement, the embodiment of the 'iron fist in a velvet glove' cliché. I returned bubbling with excitement and grasping for ways to amply describe the immensity of the experience of controlling a machine that was both a quantum leap faster than anything else then available and yet provided a relaxed and manageable ride. I couldn't wait to let one loose on the test strip at MIRA to find out how fast it really was.

That opportunity came the following year. Remember that in those days, new bikes weren't launched to the press on racing tracks in sunny climes. Dealers could sell everything they could lay their hands on and test bikes usually only became available when sales needed a boost.

That day came in August 1973, and it was a hot one. The thermometer hovered at 80 deg F (27 deg C) and a light breeze drifted across the timing straight. The late Bob Currie switched on the electronic equipment in the hut half way down the black strip of bitumen and I wound the big four to the 8500rpm red line through the five gears.

For the sake of stability we used to take the handlebar mirrors off for test runs because to get the least drag, I had to hold the left fork leg rather than the left grip. But though I was cautious on that first run the bike still clocked a stunning 127.44mph. Even with



FNU 414L of 1973. Are you still around?

THE MIRA FILES...THE MIRA FILES...

its rider sitting normally it still was capable of an arm-wrenching 117mph.

I sensed there was much more to come. Perfectly geared in top, it pulled 8500rpm in top gear to clock 131.89mph downhill: the average of the two opposed runs of 130.54mph made it the fastest ever production road bike.

The acceleration figures were no less brilliant. And from the 14 runs through the quarter mile that were recorded, it indicates that the bike coped easily with being caned. Many bikes I tested later that attempted to emulate the Z1 were much less robust.

Blitzing through the quarter at a mean 12.55 seconds with a terminal speed of 107.55mph was just business as usual for the Z1 and set a new benchmark for motorcycle performance.

A Z1 rider could happily know that there was almost nothing that could match the big four for speed. But when it came to bend swinging, the bike was still in the dark ages. A steep head angle of 64-degrees (26 degrees in today's parlance) combined with spindly fork legs demanded that the rider use body English to maintain a line in corners at modest speeds. At higher speeds it would develop a nodding that was more annoying than dangerous.

The pre-production bike John travelled to Holland ride in 1972.

KAWASAKI'S hottest rod had, however arrived just before the Yom Kippur War in the Middle East that multiplied fuel prices. Performance soon became a dirty word. So it was easy for Kawasaki to respond by detuning the bike's first substantial incarnation, the Z900 which was introduced for the 1976 model year.

This bike came with carbs reduced in choke size from 28mm to 26mm, a larger 16.5 litre fuel tank, improved rear shocks, an optional second front brake disc plus a number of other detail changes.

It was no surprise that the Z900 was much slower than the original Z1. I tested it just before Christmas 1975 and it clocked a mean top speed of just 125.5 mph. Acceleration had been spiked too with the quarter mile time longer by half a second at 13.15 seconds, not much quicker than a Norton Commando or Triumph Trident. Few would nonetheless miss the top-end rush that the four offered: for most riders the Z900 still offered huge reserves of power.

For those in the know, the announcement that Kawasaki's range-topping machine for 1977 would be opened up to 1015cc by the use of 70mm rather than 66mm pistons was great news, especially as the modifications would restore the peak power to 83ps at 8000rpm. Other changes for the Z1000 included beefier tubes and extra gusseting for the frame, triple discs (one front and rear for the US market) and a four-into-two exhaust system.

And acceleration was partly restored to the original Z1's gusto. In September 1977 I zipped the machine through the quarter mile in 12.65 seconds with a terminal of 105.24mph. But the top speed was even slower than the Z900. The best we could coax from the bike was a mean 124.4mph. Kawasaki had raised the overall gearing by using a 33-tooth rear sprocket instead of the original 35-tooth, which at 8500rpm equated to 138mph, possibly to get the bike through increasingly stringent noise regulations.

The triple disc brakes proved to be potent in the MIRA tests, recording a stopping distance of 27 feet from a corrected 30mph. They also offered a remarkable degree of sensitivity for hard braking from speed. But in the wet the stainless steel discs were appallingly weak.

THE MIRA FILES...THE MIRA FILES..

Four years on but the 1977 Z1000 was still slower than the original Z1.

Competition was arriving from other Japanese factories by now. Suzuki's GS750 four in 1976 showed that bikes from the East could handle almost as well as the Italians. And there were bigger versions on the horizon, with Honda soon to replace its CB750 with a 16-valve 900cc version.

Kawasaki's response in 1978 was the cafe-racer Z1-R with more angular styling featuring a handlebar fairing, a four-into-one pipe, drilled brake discs and light-alloy wheels. The front wheel diameter was also reduced from 19 inches to 18 inches, enabling a wider range of tyres to be used. But it also ruined the steering, making the bike even more of a tea-trolley at medium speeds than before.

Power was up to a claimed 90ps at 8000rpm, so surprises were expected at the test track in February 1978... but there were none. The Z1-R was, at 127.16 mph flat out, still three mph short of the original Z1 and with a

John had to wait until 1983 and the Z1000R to ride a big Z that was better all round than the Z1.

THE MIRA FILES...THE MIRA FILES...

The restyled Z1-R of 1978. Good looks but the big four was beginning to show its age.

Kawasaki performance data

All figures compiled at Motor Industry Research Association's proving ground, Nuneaton, Warwickshire.

MODEL:	Z1	Z900	Z1000	Z1R	Z1000R
DATE OF TEST:	16-8-73	22-12-75	6-9-77	16-2-78	4-8-83
REG NO:	FNU 414L	MLE322P	ULL744R	VLM237S	na
CONDITIONS:	Sunny	Cold	Cloudy	4 deg C	na
	80 deg F	40 deg F	Windy	10mphwind	na
MEAN TOP SPEED (MPH)	130.54	125.56	124.41	127.16	133.79
BEST ONE-WAY (MPH)	131.89	132.54	131.04	129.69	137.19
MEAN NORMALLY SEATED (MPH)	116.92	107.46	113.02	116.17	127.50
STANDING QUARTER-MILE:					
(MEAN SECS/MPH)	12.55/	13.15/	12.65/	12.65/	12.28/
	107.55	106.70	105.24	106.26	109.74
ACCELERATION (SECS/MPH)					
110YARDS	4.6/68.1	5.4/65.5	4.9/64.3	4.9/68.2	-
220YARDS	8.2/86.7	8.2/84.7	8.5/84.3	7.4/87.0	-
330YARDS	10.4/98.5	10.9/97.7	10.6/96.9	9.7/98.6	-
CONST. SPEED MPG@MPH					
30	72.0	82.0	75.2	67.2	-
50	67.2	64.0	68.8	60.8	-
70	44.8	48.0	48.0	46.4	-
BRAKING DISTANCE (FEET)					
(FROM 30MPH)	28.4	24.0	27.1	28.5	-
TURNING CIRCLE (FT)	15.3	15.3	16.0	15.5	-
SPEEDO ACCURACY, ACTUAL MPH AT INDICATED:					
30	27.3	27.2	26.9	27.4	29.4
50	45.8	44.4	45.9	45.8	47.6
70	65.4	64.3	63.8	64.2	65.2
90	82.9	80.8	-	83.0	-
TEST WEIGHT (1GAL FUEL):	528lb	-	550 lb	552 lb	-
OVERALL TEST MPG	-	-	43.0	40.9	42.3
NOTES	15/33 gearing				

NB: Rickman Kawsaki 900 tested 22/7/75 JRU 455N mean 128.3mph, best 134.6mph, standing quarter mile 12.75s@106.84 mph; 34mpg overall.

quarter mile time of 12.65 seconds with a terminal of 106.26mph, starting to show its age. Suzuki's GS1000, tested three months later, was faster, quicker... and handled.

Kawasaki had to make significant improvements to enable its sports bikes to emulate the exploits of the factory in the US Superbike championships, but not with the huge Z1300 six that was launched in 1979. Honda was king with the 136 mph six-cylinder CBX launched in1978.

For 1979 Kawasaki brought out the Z1000 MkII with a more potent 93ps engine with squared-off camshaft covers and featuring a return of the 28mm-choke Mikunis, electronic ignition, better handling and brakes with metallic pads that offered wet-weather stopping power.

But it wasn't until 1981 that Kawasaki really woke up, relaunching the Z1000 with a completely revised engine displacing 998cc (69.4x66mm) and pumping out a claimed 102ps at 8500rpm. With better steering geometry and suspension, plus a lower riding position, this bike handled really well, possibly reflecting experience with the campaign by Eddie Lawson in winning the US Superbike series that year.

The next year the Z1000 was offered as the green Eddie Lawson Replica featuring a revised steering geometry that added stability. Engine details were changed, the most notable being the use of 34mm-choke Mikuni CV carbs.

By now I was editing *Which Bike?* magazine where I tested a Z1000R in August 1983. With styling cues that came from the fuel injected GPz1100's handlebar fairing, the Eddie Lawson Replica had a cut down seat, four-into-one pipe and remote reservoirs on the rear shocks to control the 10mm-longer swing arm.

This was the first Kawasaki I rode that could better the Z1 all round with acceptable handling and a 133mph top speed (and a best one way speed of 137mph). Aerodynamics also started to come into effect, the fairing enabling the rider to clock 127mph flat out while normally seated.

Acceleration too was ball park with a quarter in 12.28 seconds

at 109.74mph.

The following year, the Z1000R came with the even better 1089cc engine from the GPz1100 and 114ps but was sanitised with a four-into-two exhaust in Europe. I never got the opportunity to test this bike at MIRA, but I'm sure it would have closely matched the 140mph plus potential of the GPz1100.

1975 and our hero lights up the back tyre of the Z900 but it was five mph slower than the Z1.

KAWASAKI Z900/Z1000 SPECIFICATION

ENGINE:	aircooled in line four
CAPACITY:	903cc (66 x 66mm) Z1-Z900 1015cc (70 x 66mm), Z1000 998cc (69.4 x 66mm), Z1000J, Z1000R
VALVE OPERATION:	double overhead camshaft
COMPRESSION RATIO:	9 to 1
LUBRICATION:	wet sump
IGNITION:	Twin coil & contact breakers
CARBURATION:	four 28mm Mikuni (26mm on Z1000)
PRIMARY DRIVE:	gear
CLUTCH:	wet multiplate
GEARBOX:	five speed
FINAL DRIVE:	630 O ring chain
FINAL DRIVE RATIO:	15/35, Z1-Z900:15/33, Z1000
OVERALL RATIOS:	1st, 12.78, 2nd, 8.83, 3rd, 6.73; 4th, 5.56; 5th, 4.92 to 1 (Z1-Z900) 1st, 12.1, 2nd, 8.30; 3rd, 6.35; 4th, 5.26; 5th, 4.64 to 1. (Z1000)
PEAK POWER:	82 ps at 8000 rpm, Z1-Z900 (83 ps, Z1000)
PEAK TORQUE:	58.5 lb-ft at 6500 rpm (Z1000)
FRAME:	Duplex tubular steel cradle type
FRONT SUSPENSION:	telescopic fork
REAR SUSPENSION:	swing arm, twin shock, adjustable preload
FRONT WHEEL:	steel rim, tension spokes
REAR WHEEL:	steel rim, tension spokes
FRONT TYRE:	Dunlop Gold Seal, 3.25H19in F6 front
REAR TYRE:	Dunlop Gold Seal, 4.00H18in K87 rear
FRONT BRAKE:	single 295mm (11.7in) disc (dual discs on Z1000)
REAR BRAKE:	270mm drum, Z1-Z900 (Z1000 295mm disc)
ELECTRICAL SYSTEM:	alternator 190W, 60/55W quartz headlamp
BATTERY:	12V 14Ah
FUEL TANK:	15.5 l, Z1 (16.5 l for Z900, Z1000)
WHEELBASE:	59.25in (1504mm), Z1000
SEAT HEIGHT:	32.5in (825mm)
CASTOR ANGLE:	64 deg
TRAIL:	89mm
CLAIMED DRY WEIGHT:	506 lb dry (Z1), 550lb inc inc gal fuel (Z1000)

SUZUKI GT TRIPLES

Smooth OPERATORS

Suzuki's smaller aircooled versions of the luxury GT750 triple were in the same mould, smooth Gran Tourismo machines. John Nutting tested a number of versions in the Seventies.

NOWADAYS, ram induction is a vital feature for sports motorcycles in which an air intake at the front of the fairing pressurises the mixture and boosts power at higher speeds.

More than 30 years ago, Suzuki used its so-called Ram Air Induction for an altogether different purpose. Following the launch in 1971 of its huge GT750 two stroke triple, the Hamamatsu factory complemented the range leader with two smaller versions, the GT380 and GT550.

These were Gran Turismo machines from the same mould and very different from Kawasaki's more sporty offerings. But unlike the 750, they came with more simple aircooled engines.

And that's where the Rain Air Induction came in. It had been known for the middle cylinder of Kawasaki's triples to suffer from overheating, so Suzuki devised a cowling that enclosed the cylinder head casting that served all three pots which scooped air where it was best needed.

But as lusty and smooth tourers the GT380 and the GT550 were hardly high-performance machines, so it's arguable that the RAI was really necessary. Indeed, the idea was also used on its smaller 125cc, 185cc and 250cc twins, so it was probably more of a marketing feature.

Up to the Seventies, Suzuki had been best known for its two stroke twins, the biggest being the T500 Titan launched in 1968. That was the year that Honda's CB750 four was revealed and the superbike era started.

Originally printed in the October 2003 issue of *Classic Motorcycle Mechanics*

1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986

Ram Air cowling was supposed to cool centre pot.

SUZUKI GT380

ENGINE

Air-cooled two-stroke triple
Capacity, 371cc (54x54mm)
Valve operation, piston ports
Compression ratio, 6.7 to 1 (from export closure) 7.0 to 1 - L to A model
Lubrication, CCI pump
Ignition, Coils and contact breakers
Carburation, Three VM24SC Mikuni
Peak power, 37 bhp at 7,500 rpm
Peak torque, 27.6 lb-ft at 6,000 rpm

TRANSMISSION

Primary drive, gear
Primary ratio, 2.833 to 1 (68/24)
Clutch, wet multiplate
Gearbox, six speed
Internal ratios 2.333, 1.50, 1.105, 0.905, 0.783 & 0.703 to 1
Final drive, 50HDS chain
Final drive ratio, 2.67 to 1 (40/15) 3.00 to 1 (42/14), option
Overall ratios, 17.63, 11.33, 8.35, 6.84, 6.8 & 5.31:1

CHASSIS

Frame, Duplex tubular steel cradle type
Front suspension, telescopic oil-damped fork
Rear suspension, pivoted fork, two spring-damper units with five-position adjustable preoad.

WHEELS

Front wheel, laced spoke, steel rim
Rear wheel, laced spoke, steel rim

TYRES

Front tyre, 300S19
Rear tyre, 350S18

BRAKES

Front brake, twin-leading shoe 7-inch drum (J model) Single 275mm hydraulic disc (K to B)
Rear brake, 200mm drum

ELECTRICS

Electrical system, Alternator, 35/2W headlamp

WEIGHTS AND MEASURES

Battery, 12V-7Ah
Fuel tank, 15 litres (3.3 gal)
Wheelbase, 1,355mm (53.4in)
Seat height, 800mm (31.5in)
Castor angle, 61 deg.
Trail, 118mm (4.6in)
Weight, dry 171kg (377lb)

But although, like Kawasaki, Suzuki chose the three-cylinder arrangement it also opted for more conservative styling with twin exhaust silencers on either side of the bike for the sake of symmetry. This was to have a significant influence on the way the bike handled.

Both GT380 and GT550 reached UK dealers early in 1972, the same year that I joined the weekly newspaper *Motor Cycle* as a trainee. The first test bike to be made available by Suzuki GB in Croydon was the GT380J.

At the time, Suzuki's image had declined as a sporting manufacturer since its last world manufacturers' title in the 50cc class in 1967. Barry Sheene had almost won the 1971 title on a second-hand factory bike and production 250cc and 500cc racer twins were made in handfuls, so the 380 had no significant sporting aspirations to live up to.

Just as well. It was a soft, luxuriant, smooth and accommodating. The controls were light, the seat low. It was easy to start with the kick lever after which it emitted a subdued pokkety-pokkety note from the four pipes. In the US, Suzuki marketed the bike as the Sebring, after the racing circuit, so they had a sense of humour at least.

Its engine was derived from the 250cc X6 and GT250 series of twins with, in effect, an extra cylinder using the same 54 x 54mm bore and stroke dimensions. Lubrication was by Suzuki's crankcase cylinder injection (CCI) system in which oil from a tank was drawn by a crankshaft driven pump and fed to the ball main bearings and the rear of the cylinder walls.

To ensure that oil was fed appropriate to the engine load, the pump's output was also controlled by the throttle opening with a cable connected to the twistgrip.

At the time, electronic ignition was still a rarity and the GT380 featured three coils and contact breakers, but any timing variation was limited by the use of a countershaft with its one bearing for the breakers, rather than running them on the crankshaft, resulting in problems from heat changing the timing.

Breathing through three 24mm-choke Mikuni carburettors, the GT380 engine's peak power was a claimed 37 bhp at 7500 rpm with its maximum torque at 6000 rpm, indicating a lower level of tune than the 250cc twin.

Like the GT750, the 380's crankshaft had 120-degree throws to give regular power pulses, but this also suffers from torsional vibration, so the engine was rubber mounted. Apart from at idle at higher revs the bike was remarkably smooth, making it a delightfully comfortable cruiser capable of holding 80 mph, a speed that the upright riding position was just right for.

The frame and suspension hadn't really advanced much since the late 60s though. While the steering was slow and neutral, the front fork and rear shocks were harsh, despite the soft springing.

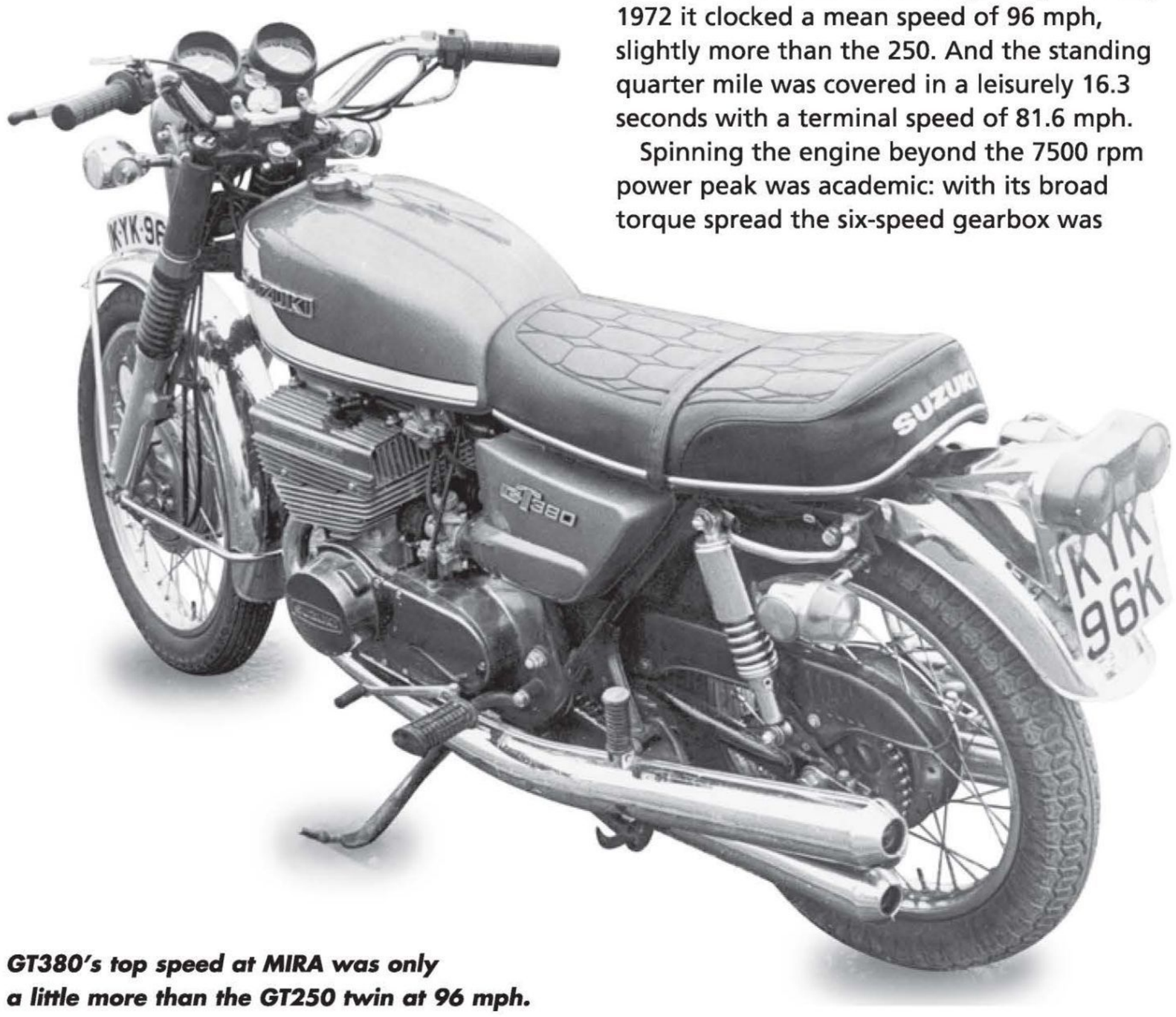
The bulk of the exhaust system dictated that the centre stand was wider than normal, so cornering clearance was limited. But increasing the preload on the rear shocks, using a tool from the kit under the seat, only offered a small respite and made the rear end even more harsh into the bargain.

It also came with a seven-inch diameter twin-leading-shoe drum brake up front, which might have been adequate on the 250 but barely enough to haul up the triple's 385 pound kerb weight.

NOT THAT SWIFT

JUST as well. The first GT380 wasn't particularly quick. Tested at MIRA's timing straight in July 1972 it clocked a mean speed of 96 mph, slightly more than the 250. And the standing quarter mile was covered in a leisurely 16.3 seconds with a terminal speed of 81.6 mph.

Spinning the engine beyond the 7500 rpm power peak was academic: with its broad torque spread the six-speed gearbox was



GT380's top speed at MIRA was only a little more than the GT250 twin at 96 mph.

largely unnecessary. As the constant-speed fuel consumption figures show, the 380 was fairly economical although when thrashed it could still drop into the 30s. With the 3.3 gallon tank and an overall consumption of 45 mpg, you could expect a range of around 130 miles before switching to reserve.

The following year, the GT380K model was fitted with a more potent disc brake, although the factory hedged its bets by applying a sticker that warned the rider that initial bite might be lessened in the wet. To their credit, changes were made to the frame and exhaust system to improve cornering clearance.

Further detail changes were made for the 1974 GT380L with altered carburettors and airbox, a digital gear indicator in the instruments, more chrome and a restyled Ram Air scoop.

Although no more power was claimed, the L-model was much quicker than the original J, indicating that porting and compression ratio changes had been made. Mean top speed at MIRA was up by six mph to almost 102 mph, although it was pulling higher gearing, revving to just 6500.

Despite this the L was also much quicker through the quarter mile, clocking 15 seconds with the terminal speed jumping to 85.4 mph. If the gearing had been correct, the Suzuki might have been as quick off the mark as Kawasaki's KH400.

Better metering in the carbs helped fuel consumption at low speeds but when the performance was pushed, the overall mpg dropped to 38. I found it difficult to better 42 mpg in general use.

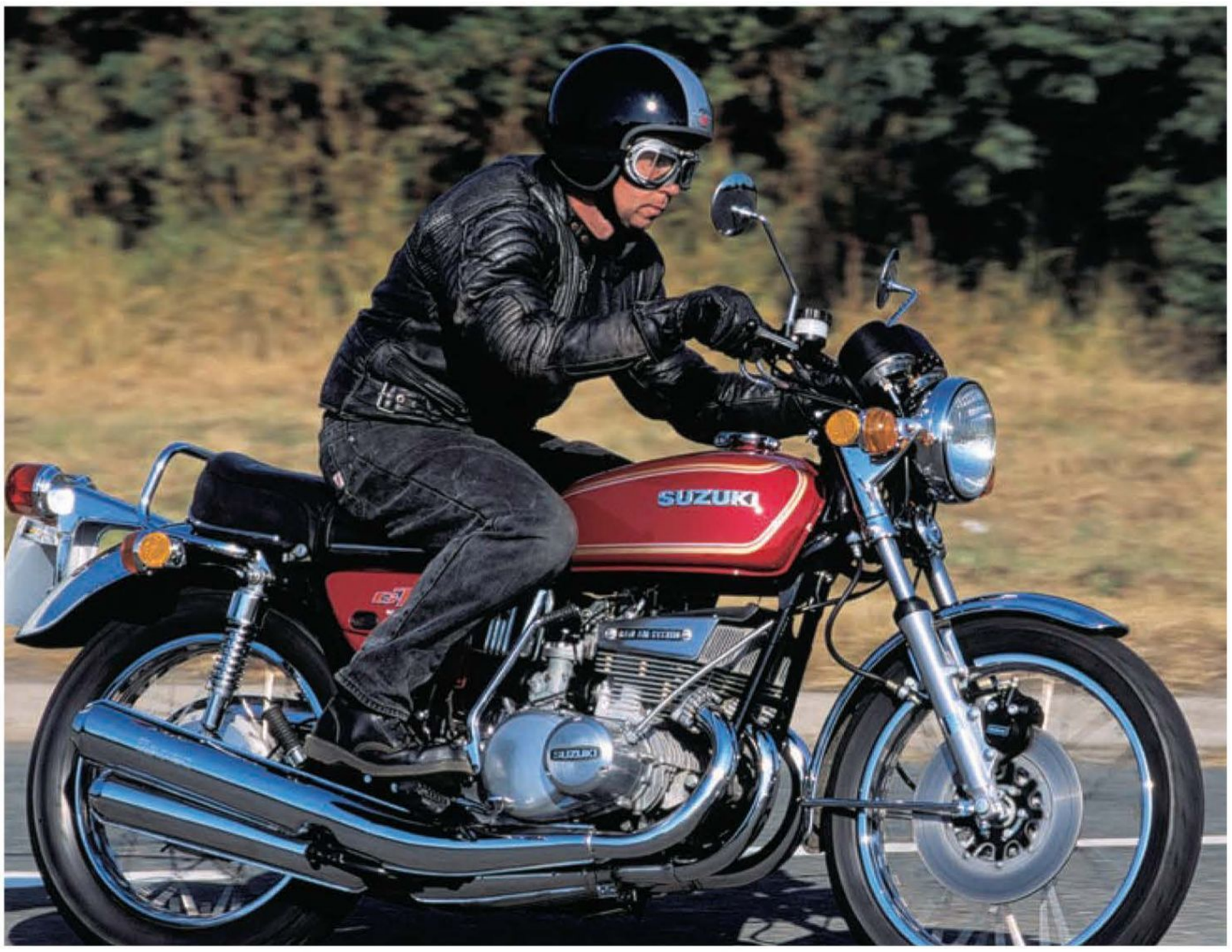
Few significant changes were made to the GT380 in the following years. As with other two stroke models in the Suzuki range, components such as the headlamp shell, the side panels and instruments were harmonised with the new four stroke models introduced for 1977.

This was the 380's final year after which it was destined to history. Few mourned its passing because there more exciting offerings in the range. As *Cycle* magazine opined: "The GT380 is like going to the movies with your sister. Nothing wrong with it, but more exciting alternatives spring readily to mind."

GT550 OFFERED MORE

EVEN the GT550 triple offered more, although it was a more bulky proposition with a weight of around 450 pounds tanked up and ready to go. It was very much a cross between the GT380 and the GT750, with a longer 57.7in (rather than 54.3in) wheelbase, bigger tyres (325H 19 and 400H 18) and when introduced in 1972 was fitted with the same large double-sided two-leading shoe drum front brake.

The engine had the same 120-deg three-



GT550's ground clearance was hampered by a wide centre stand. Front disc replaced earlier tls drum.

PERFORMANCE DATA

All figures compiled at Motor Industry Research Association's proving ground, Nuneaton, Warwickshire.

MODEL	GT380J	GT380L	GT550J	GT550L	GT550A
DATE OF TEST	25 July 1972	14 May 1974	9 Aug 1972	28 May 1974	4 March 1976
REG NO	OHU 772K	WGH 92M	NYO 907K	WGH 93M	na
CONDITIONS	na 10mph upwind	Fine, 60 deg F	na 15mph downwind	Cloudy, 55 deg F	Sunny, fine
MEAN TOP SPEED (MPH)	95.99	101.90	107.27	108.16	111.95
BEST ONE-WAY (MPH)	96.89	105.90	112.15	114.82	113.34
MEAN NORMALLY SEATED (MPH)	na	na	na	na	101.04
STANDING QUARTER-MILE (MEAN, SECS/MPH)	16.3/81.64	15.0/85.42	15.0/90,07	14.4/91.06	14.3/94.32
ACCELERATION (SECS/MPH)					
110 yards	6.7/57.0	5.9/56.5	5.7/55.7	5.1/58.7	5.2/59.7
220 yards	10.0/69.7	9.5/70.8	9.9/74.7	9.1/75.2	8.7/78.1
330 yards	13.1/77.1	12.1/79/7	12.4/81.1	11.7/84.2	11.6/85.8
CONST SPEED MPG @ MPH					
30	98.0	109.0	78.0	82.0	76.8
50	83.0	78.4	70.0	77.0	64.0
70	50.0	41.6	46.0	43.0	33.6
BRAKING DISTANCE (FEET)					
(from 30 mph)	31.75ft (9.7m)	29.5ft (8.99m)	29.5ft (8.99m)	31.5ft (9.6m)	27ft (8.65m)
TURNING CIRCLE (FT)	14ft (4.2m)	14.25ft (4.3m)	15ft (4.6m)	15ft (4.6m)	15ft (4.6m)
SPEEDO ACCURACY, ACTURAL MPH AT INDICATED					
30	27.6	27.8	29.0	29.4	28.1
50	46.5	47.9	50.6	49.1	48.7
70	67.2	68.4	68.6	69.6	68.0
TEST WEIGHT (1 GAL FUEL)		na		na	na
OVERALL FUEL CONSUMPTION		38mpg		54mpg	na

USEFUL CONTACTS

For detailed information, images, model changes (and frame numbers) and reviews about these Suzuki models go to: www.suzukicycles.org

Triple engine was basically GT250 with extra pot.

After a five year run, the GT380 was consigned to history when the four strokes came out in 1977.

SUZUKI GT550

ENGINE

Air-cooled two-stroke triple
Capacity, 543cc (61x62mm)
Valve operation, piston ports
Compression ratio, 6.7 to 1 (from ex port closure)
Lubrication, CCI pump
Ignition, Coils and contact breakers
Carburation, Three VM28SC Mikuni
Peak power, 48.5 bhp at 6,500 rpm
Peak torque, 42.8 lb-ft at 5,000 rpm

TRANSMISSION

Primary drive, gear
Primary ratio, 2.242 to 1 (74/33)
Clutch, wet multiplate
Gearbox, five speed
Internal ratios 2.846, 1.736, 1.363, 1.125 & 0.923:1
Final drive, 50HDS chain
Final drive ratio, 2.5 to 1 (40/16), 2.4 to 1 (36/15) option
Overall ratios, 15.95, 9.73, 7.64, 6.30 & 5.17:1

CHASSIS

Frame, Duplex tubular steel cradle type
Front suspension, telescopic oil-damped fork
Rear suspension, pivoted fork, two spring-damper units with five-position adjustable preload.

WHEELS

Front wheel, laced spoke, steel rim
Rear wheel, laced spoke, steel rim

TYRES

Front tyre, 325H19
Rear tyre, 400H18

BRAKES

Front brake, Four-leading shoe 8-inch drum (J model) Single 275mm hydraulic disc (K to B)
Rear brake, 200mm drum

ELECTRICS

Electrical system, Alternator, 50/40W headlamp, electric starter

WEIGHTS AND MEASURES

Battery, 12V-11Ah
Fuel tank, 15 litres (3.3 gal)
Wheelbase, 1,460mm (57.7in)
Seat height, 800mm (31.5in)
Castor angle, 61 deg.
Trail, 118mm (4.6in)
Weight, dry 200kg (440lb)

cylinder layout, but the capacity of 543cc was derived from a bore and stroke of 61 x 62mm. Breathing through 28mm carbs, the engine churned out 48.5 bhp at a modest 6500 rpm with peak torque at just 5000 rpm (according to the owner's manual). An electric starter was a standard fitting, and with so much grunt, a five-speed gearbox was enough.

It was a sublime touring machine, the motor responding well from almost any revs. But like the GT380, you were tempting fate to try hard cornering because the centre stand was even wider and lower and the suspension just as hard pressed to keep the plot under control on bumpy comers.

Some consolation was provided by the increased stopping power, though this was still improved with the fitting of the disc.

Two weeks after testing the first GT380 at MIRA I put the GT550J through its paces. It clocked a mean top speed of 107.27 mph and could cruise at 90 mph with ease. For some reason the standing quarter mile time was no better than the late GT380 at 15 seconds dead, although the terminal speed was five mph up.

Many of the detail changes made to the GT380 between 1972 and 1977 were included on the GT550, such as carburation. Some improvement in performance came with the 1974 GT550L with a top speed of 108.16 mph and a standing quarter mile of 14.4 seconds with a terminal speed of 91.06 mph. As the speeds though the intermediate distances of 100, 220 and 330 yards show, this bike was measurably quicker through the range.

It was also much more meagre with fuel. I recorded an overall figure of 54 mpg which, with the 3.3 gallon tank, offered a range of at least 160 miles. The bike was so smooth that you could really take advantage of this too.

Some reports of the time talk of a poor range, but this was during the fuel crisis of 1973 when many garages were closing at night and you really had to plan your routes carefully to avoid being stranded. A year later, the fuel might have been more costly, but at least you could get it.

Even more performance was available with the GT550A of 1976. In March of that year I tested the bike again at MIRA and this time it clocked a shade under 112 mph, some two mph quicker than Honda's CB550K3 of the following year. Again the acceleration was improved, the quarter mile dropping to 14.3s but with a far better terminal speed of 94.32 mph.

Notes for the overall fuel consumption have been lost in the mists of time, but the constant speed measurements indicate that consumption was heavier than the earlier model with a figure of about 48 mpg.

Smooth and comfortable though the GT550 was, technology was overtaking it. Suzuki's four stroke dohc GS550 four, launched soon after the GS750 at the end of 1976, was faster with a top speed of almost 115 mph and acceleration through the quarter mile of 13.7 seconds. Its weight was higher at 462 pounds, but despite this it was a better handler. The GT550 just couldn't compare.

350 AND 550 PERFORMANCE COMPARISONS

MODEL	TOP SPEED MPH	ST 1/4 MILE SECS/ MPH
Honda CB360 ohc twin	97.04	15.75/82.9
Honda CB400T ohc twin	105.9	14.6/89.1
Honda CB550F ohc four	108.8	14.6/90.9
Honda CB550K3 ohc four	110.3	14.5/91.8
Kawasaki KH400 ts triple	100.5	14.5/88.8
Kawasaki Z400 ohc twin	95.4	16.4/80.8
Suzuki GS550 ('77) dohc four	114.6	13.7/97.4
Suzuki GT380J ('72) ts triple	95.99	16.3/81.64
Suzuki GT380L ('74) ts triple	101.90	15.0/85.42
Suzuki GT550A ('76) ts triple	111.95	14.3/94.32
Suzuki Gt550J ('72) ts triple	107.27	15.0/90.07
Yamaha RD350 ('73) ts twin	103.3	14.45/88.5
Yamaha RD400E ('78) ts twin	106.6	14.30/93.3
Yamaha XS400 ohc twin	102.82	15.2/87.5

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Laverda 1000

Laverda's spectacular 1000cc Jota triple was the first standard road bike to break the 140mph barrier at MIRA's proving ground. John Nutting recalls how the bike was developed more than a quarter of a century ago.

WHEN the fastest of modern sports bikes are capable of nudging 200mph flat out - with brave testers equally capable of pushing them to their limits - it might sound absurd to recall that it wasn't so long ago that 140mph was a speed beyond the wildest dreams of road riders.

But it *was* just 35 years ago. The best road bikes, Kawasaki's Z900 being the leader of the pack, were starting to nudge 130mph at a time when high speed was out of fashion in the wake of the Yom Kippur war in the Middle East and rocketing fuel prices.

Then Laverda came along and knocked everyone to their senses. The little factory in northern Italy had been making limited numbers of a three-cylinder 981cc muscle machine, the 3C. It made its mark, however, when UK importer Slater Brothers decided to breath on the bike as a means of grabbing glory in the nascent Avon Roadrunner production bike race series.

Launched in 1973, the 3C was far more than one of Laverda's 750cc SF twins with an extra cylinder. Although such an ohc triple prototype had been produced in 1969, the machine commercialised by the brothers Massimo and Piero Laverda featured double overhead camshafts and brutally elegant styling resulting from a huge headlamp and three exhaust pipes tucked under the crankcases to provide excellent (for the time) cornering clearance.

Performance oozed from the bike and it sounded much more aggressive than its emasculated Japanese counterparts because of the novel 180-degree crankshaft arrangement - the middle piston was at top-dead-centre when the outers were at bottom-dead-centre. It barked its supremacy shamelessly.

In those days factory launches in sunny resorts or on race tracks were still very rare events. Chances are that Laverda's motorcycle business (a sideline from its agricultural equipment) couldn't afford it. So the first of the 3C triples I could get my hands on as a tester for the weekly *Motor Cycle* newspaper was provided by Essex dealer Ongar Motorcycles six months after its Italian debut.

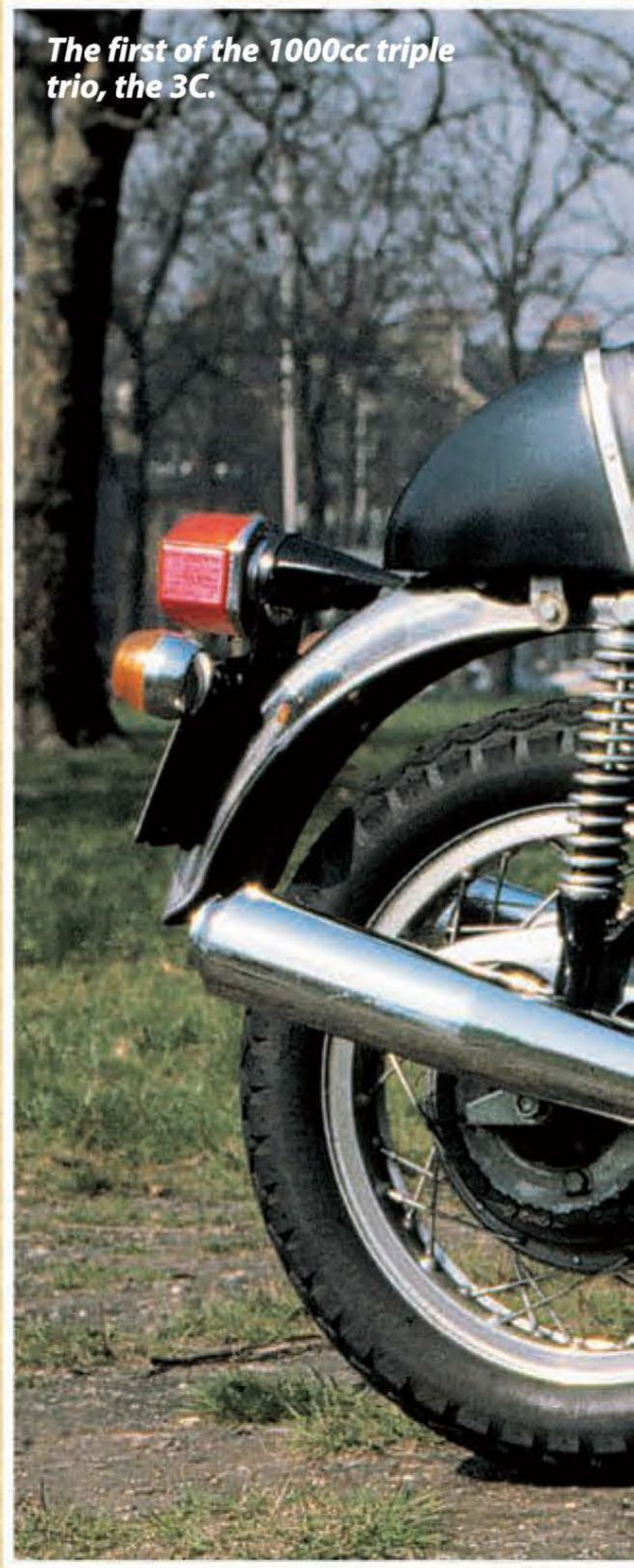
That bike, however, established a reputation that would remain with the marque forever. Big and brutal, the 3C was a bike for hard riders who didn't care that performance had to be suffered for with heavy controls and stiff suspension. Novel too were the adjustable footrests and clip-on handlebars, and an optional race style seat. Looks alone were enough to sell it.

When I took the bike to MIRA's proving ground on a misty and cool April day in 1974, great things were expected. As the performance figures show, it took a while for me to get used to the bike's top end and how the brakes would respond to repeated flat-out stops. Unlike the debut machines that featured huge ventilated drums, the Ongar machine came equipped with dual Brembo front discs to complement the rear drum.

After a few runs at just over 125mph they were clearly up to the task, so I wound the engine to its 7500rpm red line and it topped 130mph. But with a strong headwind in the opposite direction the best the bike could manage was under 126mph for a mean two-way figure of 128.46mph. So Kawasaki's Z900 was still the king with a average 131mph. Extra performance was necessary to humble the big Kawasaki so Slaters decided to collaborate with the factory and homologate a more potent model for the following season.

Called the 3C-E (E for English market), it came with a special exhaust system made in the UK with larger outlets from the twin tailpipes. Rear wheel power was lifted from 68 to 75bhp said Roger Slater and although the exhaust, as I wrote at the time 'chimed into a screaming wail' at the peak revs of 8000rpm, it was legal in the UK.

Slaters provided a test bike for MIRA testing in 1975 and suspecting that the additional power might result in over-



The first of the 1000cc triple trio, the 3C.

The 3C became the 3C 'E' (for English)...

Originally printed in the April 2001 issue of *Classic Motorcycle Mechanics*

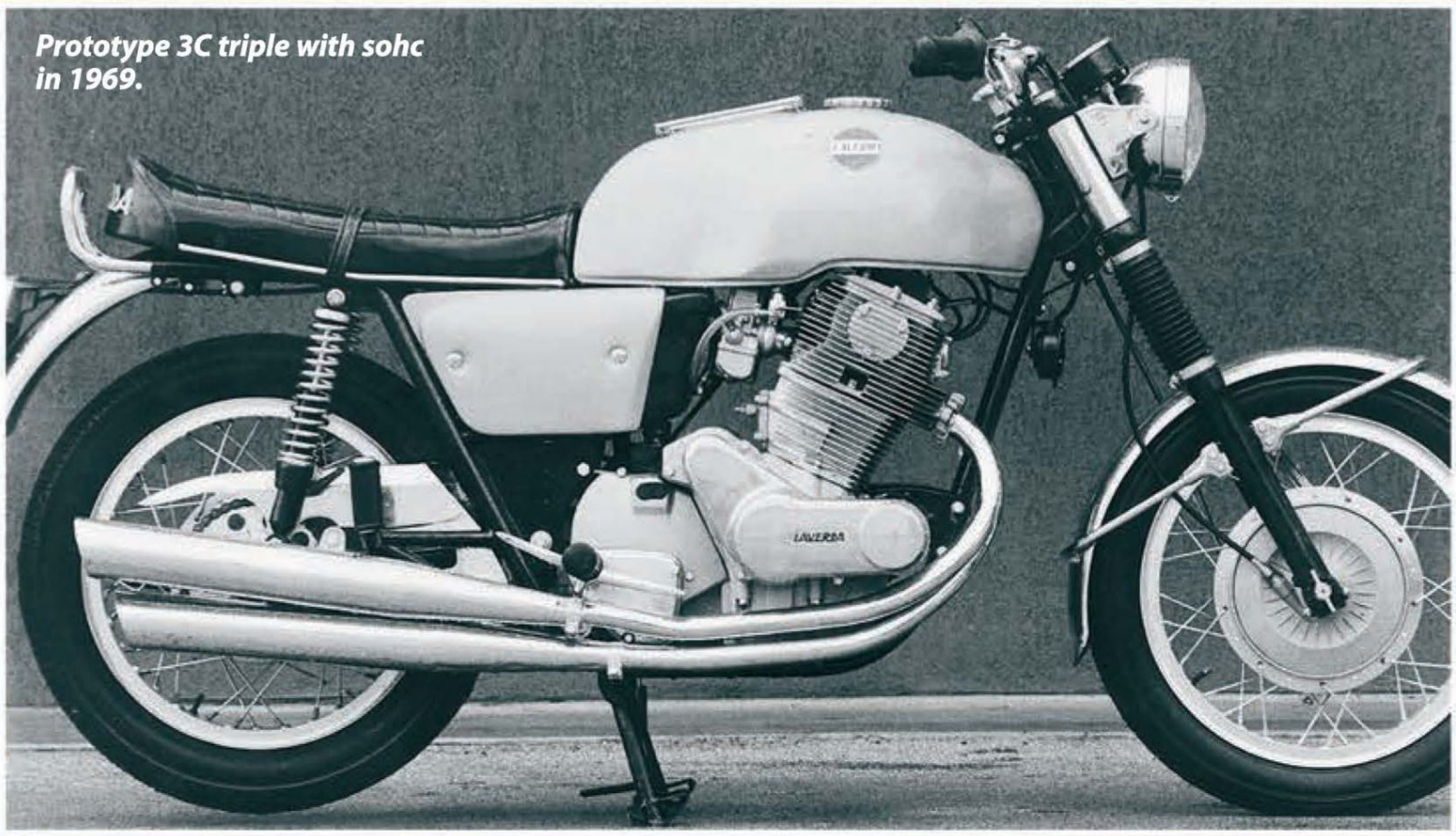
revving in top gear, fitted a 38-tooth rear sprocket to replace the standard 40-tooth item, raising the gearing to give an estimated 140mph at 7600rpm in top.

If I'd thought that the previous year's bike was a hairy proposition, the 3C-E was altogether more daunting. Today's machines with their superior aerodynamics require the rider simply to tuck inside the fairing. On the 3C-E I was hanging on in a hurricane and the slightest relaxation could lop several miles an hour off the speed. By the time I'd thundered half way down the 1300 yard timing strip, the bike was clocking 120mph and I changed up from fourth to top gear. It felt, as I wrote soon after "like riding a raging bull along a tightrope."

Downhill and with a tail wind, the bike clocked two runs at 139.64 and 139.80mph and with a best return speed into the wind of just under 127mph the mean of

...and then bestowed the name 'Jota'.

HE MIRA FILES...THE MIRA FILES...



Prototype 3C triple with sohc in 1969.

The mighty three cylinder engine from the 3C which received tuning inspired by the English importer.

the two highest speeds was 133.30mph, enough to beat the Kawasaki. If I'd thought that it would clock more that 140mph I wasn't about to try, or was able to. Attempting full-bore standing quarter mile acceleration tests was more than the clutch could take.

The taller gearing demanded no small degree of slipping to get the 522-pound bike smartly away from a standstill and started to fail. But not until the bike had clocked 12.7 seconds with a terminal speed of 108mph: the Laverda had grabbed the garland. The more potent top-end potential also exposed a weakness in the chassis. Though taut, lithe and stable most of the time, it would get flighty at more than 130mph - a characteristic that was corrected for racing by using a larger rear Dunlop Endurance KR91 tyre on a wider 2.5in rim and fitting SFC front fork yokes that offered more trail than the standard 5.5in.

TO mark the Laverda triple's new-found celebrity, it was decided to provide the bike with a name; Jota, an Italian dance in triple time, was chosen for the following 1976 model year.

Although joined in the range by the more docile 1200 triple with an 1116cc engine, the Jota was Laverda's most powerful machine and became a classic straight from the factory.

Like every good performance machine with racing connections, the Jota was offered with a number of additional options over the 3C-E. The 'works' production racer campaigned by Peter Davies had everything from the book and was tested in August 1976 at MIRA in (recorded by the late Bob Currie in the timing hut) 'nice' conditions.

To improve on the earlier bike, camshafts were different and better tuned to the exhaust system, while the air filter was removed and the carburation adjusted accordingly. Visible new features on the bike were five-spoke cast-alloy wheels, a disc rear brake and a stylish fold-up seat. For racing, Laverda offered a modified gearbox with closer ratios and this was used in the test bike. It meant that better use could be made of the more peaky power band, but with an 18 percent higher bottom gear, it was very awkward to ride in town.

Strangely, the Nippon Denso rev meter's red line was always marked from 7500 to 8500rpm; in fact the Laverda triple barked out its maximum 90bhp (at the crank) at 7600rpm and Slater said it was safe to 8500rpm.

Just in case Slater's baby didn't perform just as they hoped, Richard Slater, brother of Roger, accompanied us to the timing

Production racer Pete Davies at Mallory on the same bike John tested at MIRA.

THE MIRA FILES...THE MIRA FILES...

straight as an 'assistant', a scam that was, as a rule, strictly out of bounds. As I recall, we started by raising the overall gearing to match the 3C-E with a 38-tooth rear sprocket but it was too high for the narrower power band to pull, so we switched back to the standard gearing and the bike reeled off a series of hot runs, none of which were less than 132mph but culminated in a best one way of 140.04mph.

It wasn't, strictly speaking, a 'mean' top speed according to the way we measured such things at *Motor Cycle*, but the big Laverda had been recorded at more than 140mph, the first time that a commercially-available road bike had reached such a speed under test conditions. It was enough.

John's 1978 test Jota.

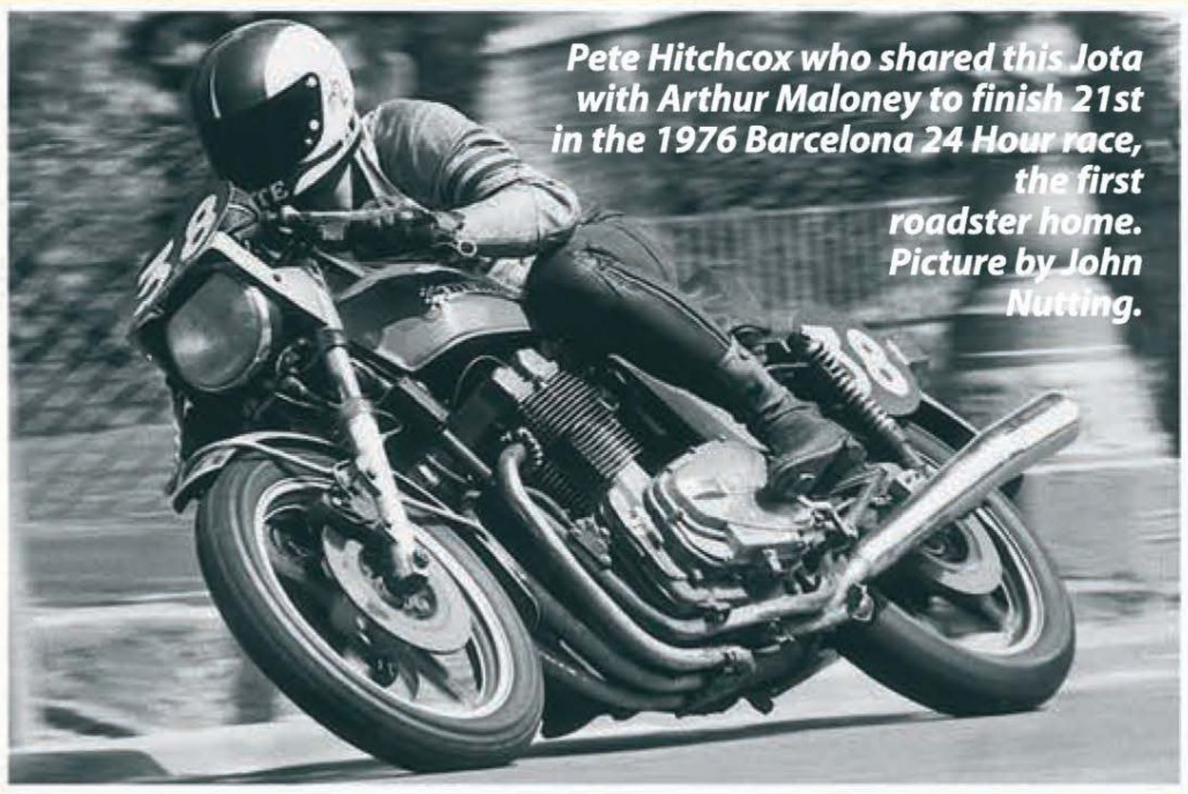
PRODUCTION racing bikes on tall gearing rarely prove to be much good at drag racing, for which the machine should be set up for quick getaways and low-speed acceleration. And so it proved with this particular Jota. I managed just three quarter-mile sprints before the clutch gave up the ghost. Once the bike got going it flew, with a terminal speed of more than 110mph. This was much higher than the Kawasaki's speed but the quarter mile time was slower by half a second at 13.05s. The tall bottom gear, good for 64mph, and the need for clutch slipping, proved too much for the friction plates, despite them being changed at the strip. The mean top speed of 137.76mph put the bike out of the reach of the Kawasaki and many other machines for two years, until the debut of better handling and more powerful Japanese machines like the Suzuki GS1000. It was the first glorious era of Italian motorcycles. The Jota will live on forever as a testimony to that period.

Laverda 1000 3C. Reg no: PPU 40M. Date: April 2 1974.

TEST CONDITIONS:	misty, cold			
AIR SPEED:	strong			
AMBIENT TEMP:	50 deg F			
RIDER:	John Nutting			
RIDER WEIGHT:	168 lb			
CLOTHING:	one-piece leathers			
TOP SPEEDS PRONE, MPH:	East: 125.19/126.59/124.60/131.34/130.40			
	West: 23.09/124.29/125.59/125.40/125.34			
MEAN OF BEST OPPOSED SPEEDS, MPH:	128.46			
BEST ONE-WAY SPEED, MPH:	131.34			
TOP SPEED, NORMALLY SEATED, MPH:	East: na, West: na			
MEAN OF BEST OPPOSED SPEEDS:	na			
ACCELERATION, STANDING QUARTER MILE, SEC:	East: 13.3/13.6/13.1/13.0/13.2			
TERMINAL SPEEDS, MPH:	103.89/103.99/105.05/105.85/104.95			
ACCELERATION, STANDING QUARTER MILE, SEC:	West: 13.5/13.4/13.1			
TERMINAL SPEEDS, MPH:	102.95/102.50/104.35			
MEAN TIME @ TERMINAL:	13.05secs @ 105.35mph			
SPEEDOMETER ACCURACY:				
IND MPH:	30	50	70	90
ACT MPH:	28.1	46.2	69.6	92.4
FUEL CONSUMPTION (FROM DISTANCE TRAVELLED ON HALF PINT OF FUEL):				
CORRECTED SPEED, MPH:	30	50	70	
DISTANCE (MILES):	4.0	3.9	2.9	
MPG:	64.0	62.4	46.4	
BRAKING DISTANCE (FROM CORRECTED 30MPH):	28ft 0in			
TURNING CIRCLE:	16ft 0in			
TEST WEIGHT (INC ONE GAL OF FUEL):	522 lb			

Laverda 1000 3CE. Reg no: HVJ 3N. Date: July 22nd 1975.

TEST CONDITIONS:	cloudy, dry			
AIR SPEED:	0-20mph			
AMBIENT TEMP:	na			
RIDER:	John Nutting			
RIDER WEIGHT:	168 lb			
CLOTHING:	one-piece leathers			
TOP SPEEDS PRONE, MPH:	East: 139.64/139.80			
West: 125.64/126.89				
MEAN OF BEST OPPOSED SPEEDS, MPH:	133.3			
BEST ONE-WAY SPEED, MPH:	139.80			
TOP SPEED, NORMALLY SEATED, MPH:	East: na, West: na			
MEAN OF BEST OPPOSED SPEEDS:	na			
ACCELERATION, STANDING QUARTER MILE, SEC:	East: 13.0/na			
TERMINAL SPEEDS, MPH:	104.43/103.59			
ACCELERATION, STANDING QUARTER MILE, SEC:	West: 12.8/12.8/12.6			
TERMINAL SPEEDS, MPH:	109.99/109.89/111.05			
MEAN TIME @ TERMINAL:	12.7s @ 107.74mph			
SPEEDOMETER ACCURACY:				
IND MPH:	30	50	70	90
ACT MPH:	30.01	49.99	70.58	na
FUEL CONSUMPTION (FROM DISTANCE TRAVELLED ON HALF PINT OF FUEL):				
CORRECTED SPEED, MPH:	30	50	70	
DISTANCE (MILES):	5.0	4.2	2.9	
MPG:	80	67.2	46.4	
BRAKING DISTANCE (FROM CORRECTED 30MPH):	29ft 0in			
TURNING CIRCLE:	16ft 0in			
TEST WEIGHT (INC ONE GAL OF FUEL):	522 lb			



Pete Hitchcox who shared this Jota with Arthur Maloney to finish 21st in the 1976 Barcelona 24 Hour race, the first roadster home. Picture by John Nutting.

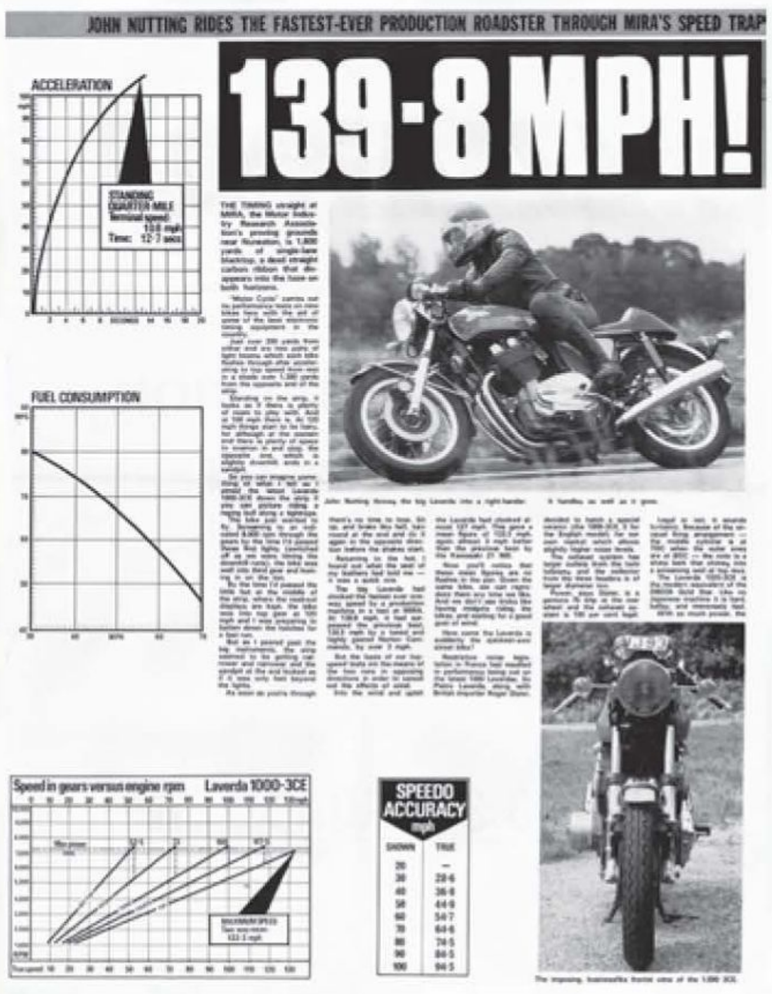
Development of the Jotas as tested

	3C	3CE	Jota
Peak power	80bhp @ 7,250rpm (68 @ rear wheel)	85bhp @ 7,600rpm (75 @ rear wheel)	90bhp @ 7,600rpm
Internal gear ratios	2.618 1.883 1.373 1.173 1.000	2.618 1.883 1.373 1.173 1.000	2.214 1.607 1.269 1.083 1.000
Final drive	40/19	38/19	40/19
Overall ratios(& mph at peak power)	11.24 (48) 8.08 (67) 5.89 (92) 5.03 (107) 4.29 (126)	10.68 (53) 7.68 (74) 5.60 (101) 4.78 (118) 4.08 (138)	9.51 (59) 6.90 (82) 5.45 (104) 4.65 (121) 4.29 (132)

Laverda 1000 Jota. Reg no: MFO 307P. Date: August 10th 1976.

TEST CONDITIONS:	'Nice'			
AIR SPEED:	na			
AMBIENT TEMP:	na			
RIDER:	John Nutting			
RIDER WEIGHT:	168 lb			
CLOTHING:	one-piece leathers			
TOP SPEEDS PRONE, MPH:	East: 134.74/132.39/135.49/134.89 West: 138.99/139.84/137.39/140.04			
MEAN OF BEST OPPOSED SPEEDS, MPH:	137.76			
BEST ONE-WAY SPEED, MPH:	140.04			
TOP SPEED, NORMALLY SEATED, MPH:	East: 123.00, West: 128.89			
MEAN OF BEST OPPOSED SPEEDS, MPH:	125.95			
ACCELERATION, STANDING QUARTER MILE, SEC:	East: 13.6/13.2			
TERMINAL SPEEDS, MPH:	110.54/110.65			
ACCELERATION, STANDING QUARTER MILE, SEC:	West: 12.9			
TERMINAL SPEEDS, MPH:	110.45			
MEAN TIME @ TERMINAL:	13.05 secs @ 110.55mph			
SPEEDOMETER ACCURACY:				
IND MPH:	30	50	70	90
ACT MPH:	28.95	47.89	69.86	na
FUEL CONSUMPTION (FROM DISTANCE TRAVELLED ON HALF PINT OF FUEL):				
CORRECTED SPEED, MPH:	30	50	70	
DISTANCE (MILES):	4.6	3.6	2.8	
MPG:	73.6	57.6	44.8	
BRAKING DISTANCE (FROM CORRECTED 30MPH):	25ft 6in			
TURNING CIRCLE:	16ft 0in			
TEST WEIGHT (INC ONE GAL OF FUEL):	522 lb			

Postscript performance



JOHN NUTTING RIDES THE FASTEST-EVER PRODUCTION ROADSTER THROUGH MIRA'S SPEED TRAP

139-8 MPH!

ACCELERATION

STANDING QUARTER MILE
Terminal speed: 110 mph
Time: 12·7 secs

FUEL CONSUMPTION

Speed in gears versus engine rpm — Laverda 1000-3CE

SPEEDO ACCURACY mph

SHOWN	TRUE
20	–
30	28·6
40	36·8
50	44·9
60	54·7
70	64·6
80	74·5
90	84·5
100	94·5

Laverda's 1,000-3CE breaks top speed barrier

SPECIFICATION

SLATER BROS
UK CONCESSIONAIRES
100% SPARES ★ SERVICE
PERSONAL EXPORT ★ SALES
DEMONSTRATORS AVAILABLE
WRITE, PHONE OR CALL
SLATER BROS, COLLINGTON BROMYARD, HEREFORDSHIRE
TEL: KYRE 294/5 TELEX: 35402.
(3 Miles out of Bromyard on the Tenbury Wells Road)

How John reported his speed successes on the 3CE and Jota in Motor Cycle in 1975 and '76.

IT'S worth noting that when I tested the Jota 120 in 1982 for *Which Bike?* magazine, it had become a much more refined machine and had lost only a little performance compared to the first model year six years earlier. To cope with the different vibration characteristics of the 120-degree crank, the engine was rubber mounted, making it much smoother. A by-product of this was that the carbs were less upset and allowed an 800rpm idling speed.

Other changes included twin primary chains that were smoother than the original triplex chain on the overrun, and a more silky left side gearchange mechanism.

The engine would rev harder to 8000 rpm and on slightly lower overall gearing. Top gear was 4.335 to 1 with 16/34 final drive sprockets for the sealed 630 chain enabling the Jota 120 to take advantage of a wider power band. With a strong tail wind, the bike clocked a best one-way speed of 140.84mph on the timing straight, but the mean top speed was lower than Slater's production racer at 134.7 mph.

With wider ratios in the five speed box, the bike was much quicker through the quarter mile however, recording a mean 12.45 seconds at 110.05 mph.

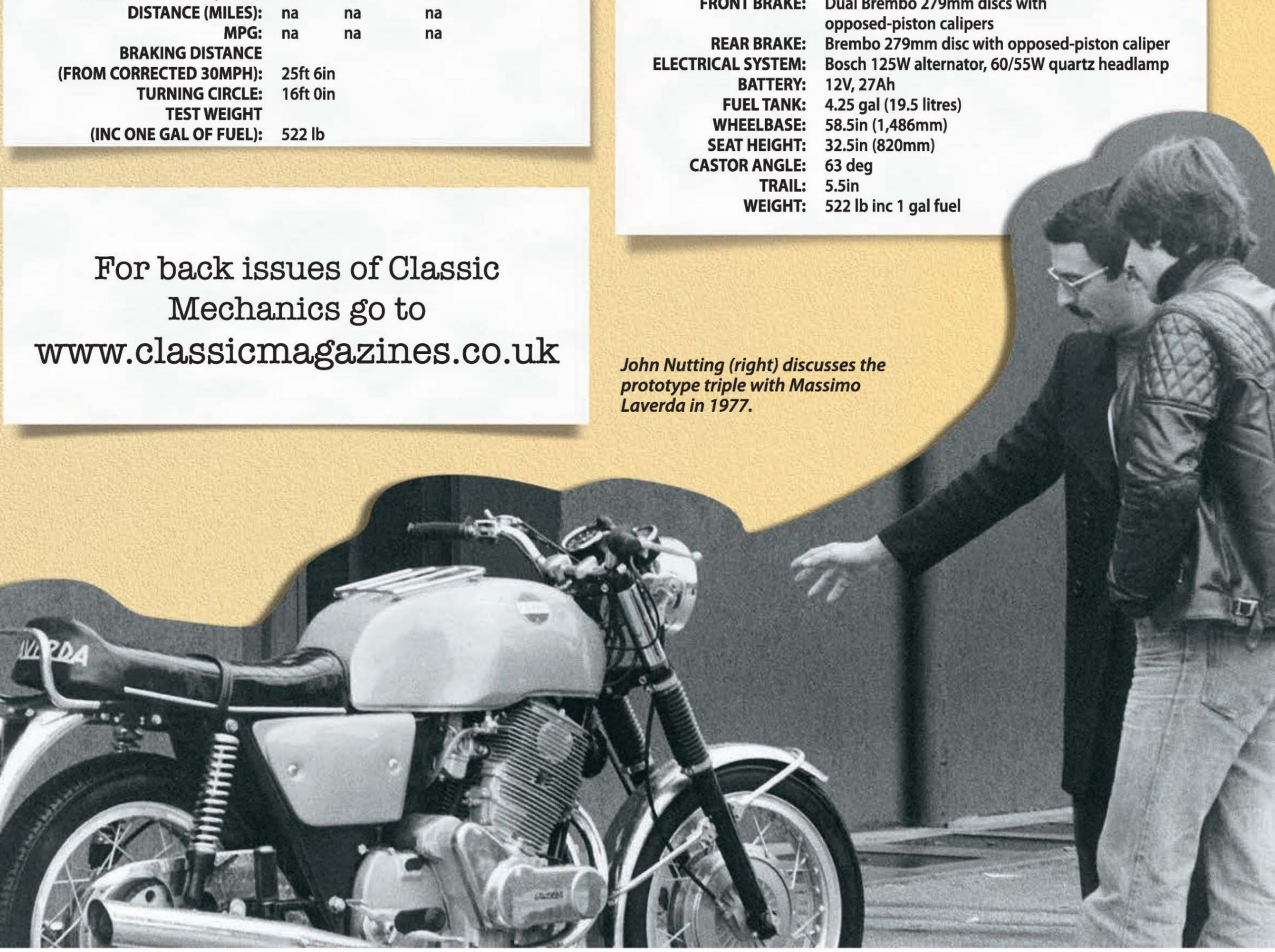
TEST REPORT

Laverda 1000 Jota 120. Reg no: n/a. Date: March 3 1982

TEST CONDITIONS:	na			
AIR SPEED:	20mph approx			
AMBIENT TEMP:	na			
RIDER:	John Nutting			
RIDER WEIGHT:	168 lb			
CLOTHING:	one-piece leathers			
TOP SPEEDS PRONE, MPH:	East: 140.84/140.49			
	West: 127.44/128.49			
MEAN OF BEST OPPOSED SPEEDS, MPH:	134.66			
BEST ONE-WAY SPEED, MPH:	140.84			
TOP SPEED, NORMALLY SEATED, MPH:	East: 137.07, West: 119.70			
MEAN OF BEST OPPOSED SPEEDS, MPH:	128.38			
ACCELERATION, STANDING QUARTER MILE, SEC:	East: 12.16			
TERMINAL SPEEDS, MPH:	113.80			
ACCELERATION, STANDING QUARTER MILE, SEC:	West: 12.98/12.88/12.65			
TERMINAL SPEEDS, MPH:	106.29/106.79/106.29			
MEAN TIME @ TERMINAL:	12.41 secs @ 110.05mph			
SPEEDOMETER ACCURACY:				
IND MPH:	30	50	70	90
ACT MPH:	31.13	48.61	68.96	na
FUEL CONSUMPTION (FROM DISTANCE TRAVELLED ON HALF PINT OF FUEL):				
CORRECTED SPEED, MPH:	30	50	70	
DISTANCE (MILES):	na	na	na	
MPG:	na	na	na	
BRAKING DISTANCE (FROM CORRECTED 30MPH):	25ft 6in			
TURNING CIRCLE:	16ft 0in			
TEST WEIGHT (INC ONE GAL OF FUEL):	522 lb			

LAVERDA JOTA 1000 SPECIFICATION (1976 MODEL)

ENGINE:	air-cooled in-line 180-deg triple
CAPACITY:	981cc (75 x 74mm)
VALVE OPERATION:	double overhead camshafts
COMPRESSION RATIO:	10 to 1
LUBRICATION:	wet sump
IGNITION:	Bosch electronic magneto
CARBURATION:	three 32mm Dellorto
PRIMARY DRIVE:	Triplex chain
PRIMARY RATIO:	2.04 to 1
CLUTCH:	wet multiplate
GEARBOX:	five speed
INTERNAL RATIOS:	1st, 2.214:1, 2nd, 1.607:1, 3rd, 1.269:1, 4th, 1.088:1, 5th, 1:1
FINAL DRIVE:	Regina 5/8 x 3/8in chain
FINAL DRIVE RATIO:	40/19, 2.105:1
OVERALL RATIOS:	9.51, 6.9, 5.45, 4.65 and 4.29 to 1
PEAK POWER:	90 bhp at 7,600 rpm
PEAK TORQUE:	na
FRAME:	Duplex tubular steel cradle
FRONT SUSPENSION:	Ceriani telescopic fork
REAR SUSPENSION:	swing arm, twin Ceriani shocks, adjustable preload
FRONT WHEEL:	five-spoke cast alloy, 18in
REAR WHEEL:	five-spoke cast alloy, 18in
FRONT TYRE:	Dunlop TT100 410 x S18
REAR TYRE:	Dunlop TT100 425 x S18
FRONT BRAKE:	Dual Brembo 279mm discs with opposed-piston calipers
REAR BRAKE:	Brembo 279mm disc with opposed-piston caliper
ELECTRICAL SYSTEM:	Bosch 125W alternator, 60/55W quartz headlamp
BATTERY:	12V, 27Ah
FUEL TANK:	4.25 gal (19.5 litres)
WHEELBASE:	58.5in (1,486mm)
SEAT HEIGHT:	32.5in (820mm)
CASTOR ANGLE:	63 deg
TRAIL:	5.5in
WEIGHT:	522 lb inc 1 gal fuel



John Nutting (right) discusses the prototype triple with Massimo Laverda in 1977.

From the pen *of a genius*

Bimota's SB2 was both the Italian factory's and Massimo Tamburni's first production road bike design. John Nutting tested in the Isle of Man in 1978.

Originally printed in the September 2008 issue of *Classic Motorcycle Mechanics*

Bimota, the small Italian manufacturer that's been through more than its share of financial problems in recent years, developed a huge reputation in the 1970s and 80s as the source of not just fine-handling exotic sporting motorcycles but of two-wheel artistic expression.

That reputation was originally built on providing frames for road racing and later road bikes powered by a variety of Japanese four-cylinder engines.

And so strong was the brand that even after it collapsed when trying to offer its own esign of fuel-injected 500cc two-stroke twin, it was revived in 2003 by Roberto Comini and still makes 'hand-crafted' alternative sports bikes, now powered by Ducati V-twins.

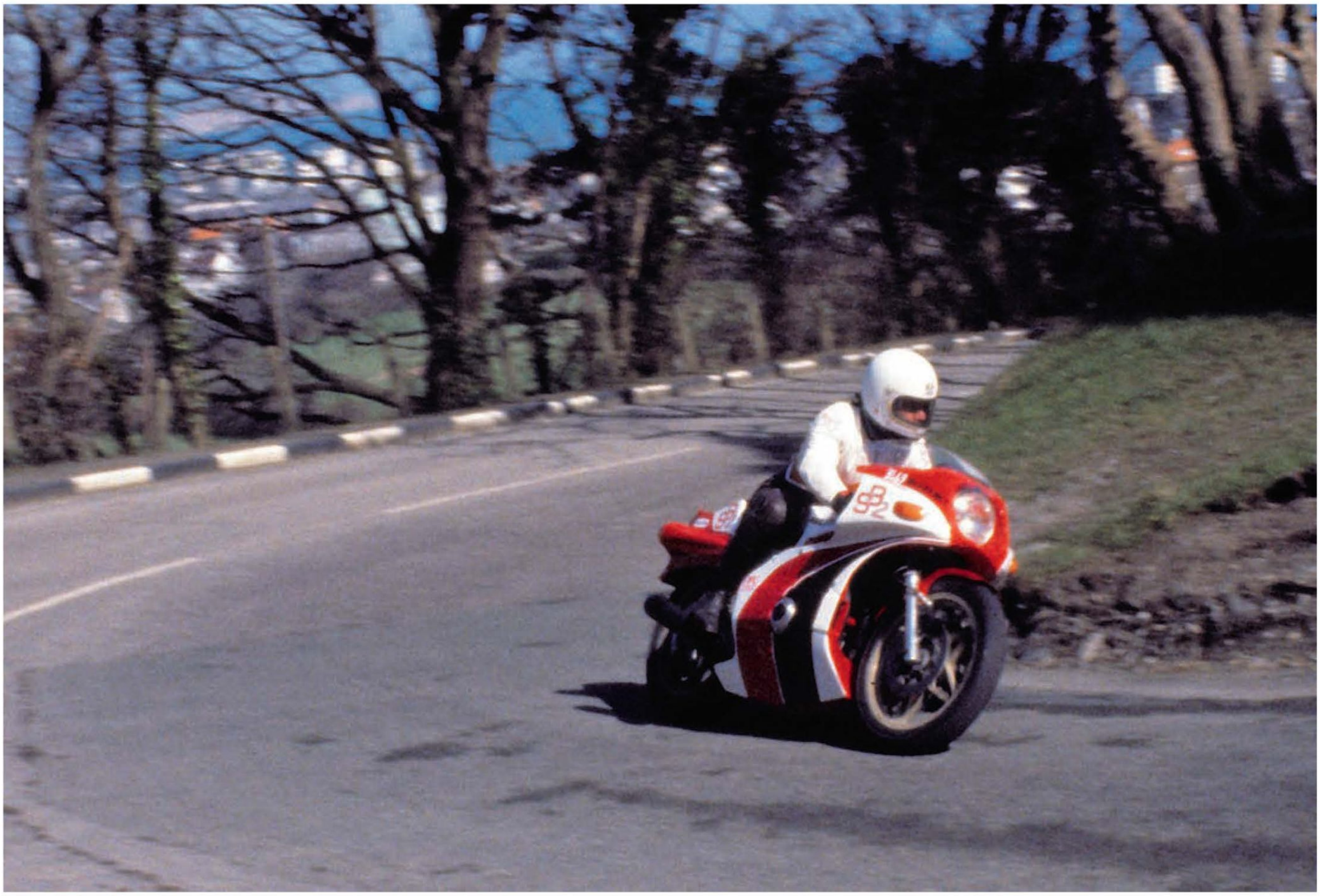
Older riders might cynically suggest that the factory, still at Rimini on the Adriatic coast, has been exploiting past glories. It's a lot more difficult nowadays to improve on the offerings of the leading factories. But it was no easier three decades ago.

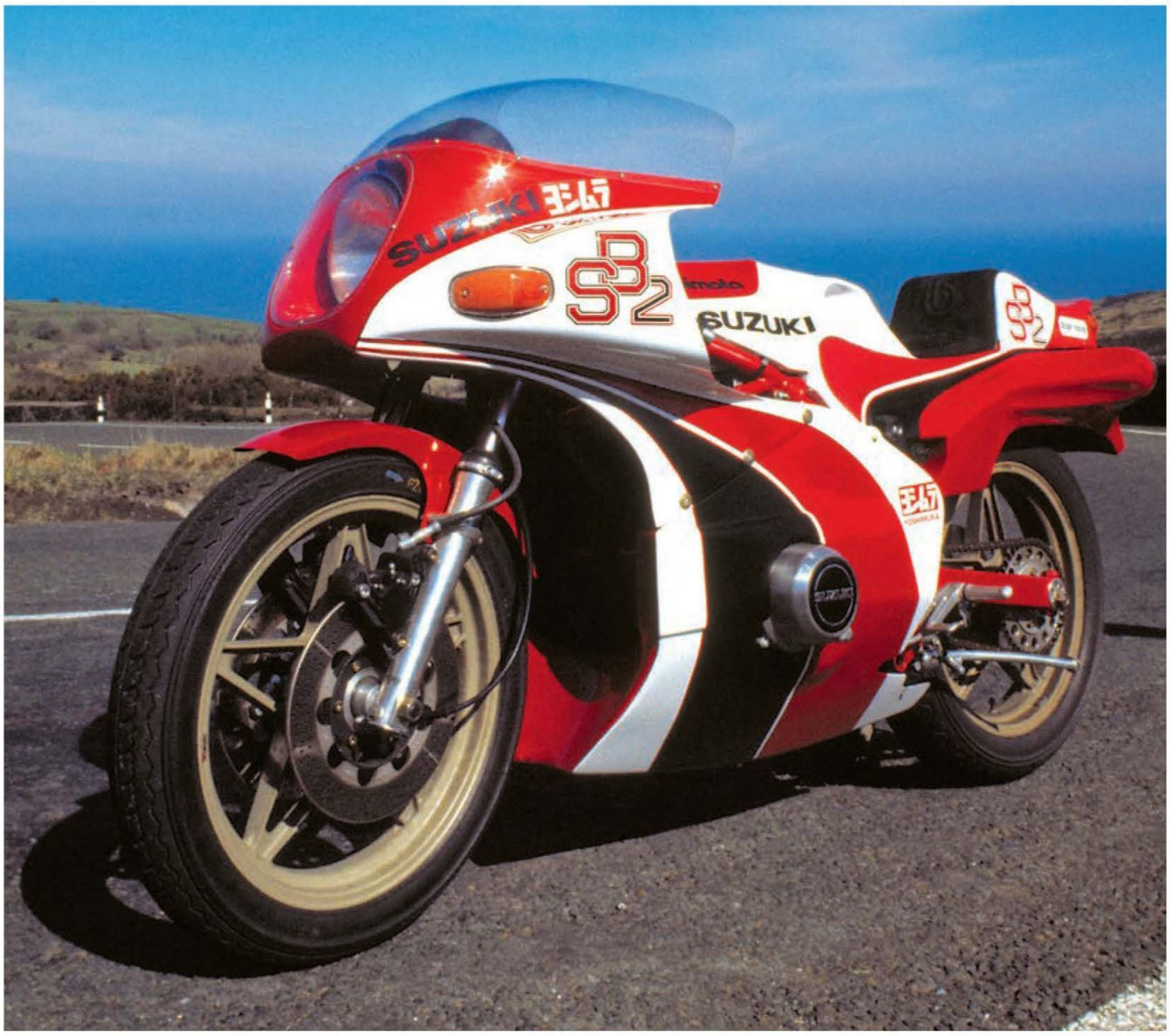
Small-scale manufacture of racing frames was more craft than science. But the craft was exquisitely executed by Bimota and by helping to win world championships proved that its engineering skills were second to none. Most memorable was the works Harley-Davidson 250cc two-stroke twin using a multi-tube space frame made in 1975 by Bimota in which the swingarm pivoted on the same axis as the drive-chain sprocket so that the action single spring-damper unit – another innovation – was less affected by the power delivery.

The designs came from the fertile mind of a young Massimo Tamburini who had set up Bimota with colleagues Valerio Bianchi and Giuseppe Morri in 1973. By 1976 he was using similar features in laying out the factory's first production road bike.

Six months later I was riding the first SB2 to arrive in the UK on the Isle of Man TT course. It was April, just five weeks before the TT fortnight and fans were being whipped into a frenzy of anticipation that the legendary Mike Hailwood would be coming out of retirement to race a Ducati in the Formula 1 event.

The Bimota had been shipped over to the Island by the newly appointed agent David Dixon, also the importer of Yoshimura tuning





kits, so that Cheshire dealer Bill Smith, who had been entered for the F1 race, could give the bike a shake down.

To provide some advance publicity I, as road tester at the weekly paper Motor Cycle, had been invited to join the fun and become the first journalist to try the SB2 in anger.

I was introduced to the bike on the Douglas waterfront. Shallow sunlight picked out the details of the red and white fairing, the smooth red paint of the frame, the gold of the cast alloy wheels. The SB2 looked like something from another planet, ratherthan Italy.

Four rubber catches at the front of the one-piece seat-tank unit were released to expose the chassis. Its frame embraced the engine tightly, chrome-molybdenum alloy steel tubing wrapping either side. Like the Harley-Davidson racer, the rear wheel's swingarm was longer than usual, attaching to large-diameter bearings at the full width of the fairing and with the same co-axial arrangement with the final drive sprocket. To enable the engine to be a tight fit, the frame was made in two parts, front and rear, joined by conical couplings in the upper spars.

> "THE DESIGNS CAME FROM THE FERTILE MIND OF A YOUNG MASSIMO TAMBURINI..."

Suspension at the rear was provided by a single Italian made Corte e Cosse spring damper unit with a linkage similar to those found on Ducatis 10 years later. Chain adjustment was by eccentric rear-wheel spindle mounts, a Bimota trademark feature.

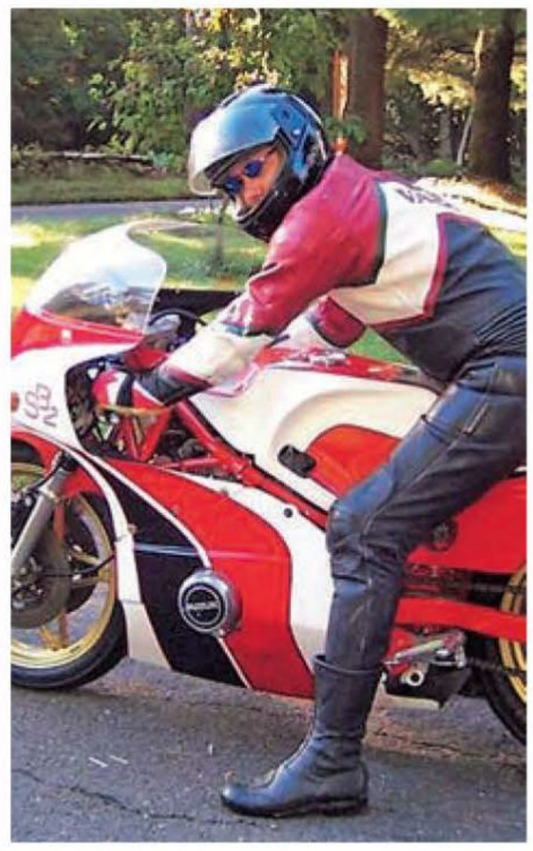
Up front, a premium Ceriani telescopic fork with 35mm diameter legs was used. But the geometry was unusual in that unlike convention in which the legs are parallel to the steering head, the specially machined yokes set the legs at 60 degrees while the steering head angle was a conventional 64 degrees from the horizontal. The idea was to both stiffen the yokes and reduce trail as the fork compressed under braking.

Wheels were 18in lightweight aluminium alloy units to Bimota's own design to take what were for the time unusually wide tyres, Michelins with a 3.50 front and 130/80 rear widths. Brakes were the best you could specify at the time: Brembo perforated11in discs.

Watched by a young Ron Haslam, who was also in the Island to get road experience before his first Isle of Man TT, we quickly reassembled the bodywork and I sat astride the Bimota. It felt tiny with a short 54.5in wheelbase and 29.5in seat height and but for the enveloping fairing might have seemed even smaller.

Dixon switched on the ignition and I cracked the twistgrip. The engine barked into life through its four-into-one pipe. This was no stock GS750 engine. Dixon came clean: it was special 843cc motor with Yoshimura parts including gas-flowed porting, 4mm larger-diameter high-compression pistons, higher lift camshafts and smooth-bore 29mm Mikuni carburettors devoid of any filtration. It was snappy like a pit bull and declined to idle. Dixon said it developed peak power of 95bhp at 10,500rpm, up from °67bhp of the stock engine, and would rev to 11,000. Gearing was up one tooth on the engine sprocket, giving a theoretical

OWNER: BOB VAETH



Bob Vaeth, who lives in New England in the US, owns what he reckons is ne of only four Bimota SB2 machines in North America.

He bought the bike four years ago through an acquaintance who had imported it from the UK after it was brought from Italy. Frame number is 00036.

"Riding the Bimota is a revelation compared to other 70s bikes I own and have owned in the past," says Bob. "It's low and lightweight while its short wheelbase provides precision handling that is unmatched. The innovations that it pioneered set the bar very high for sport bikes for the next 15 years

"It's my absolute favourite of my small vintage collection, which includes a Laverda 750 SFC, Moto Guzzi Le Mans 1, Ducati 750 Sport and many other Italian machines.

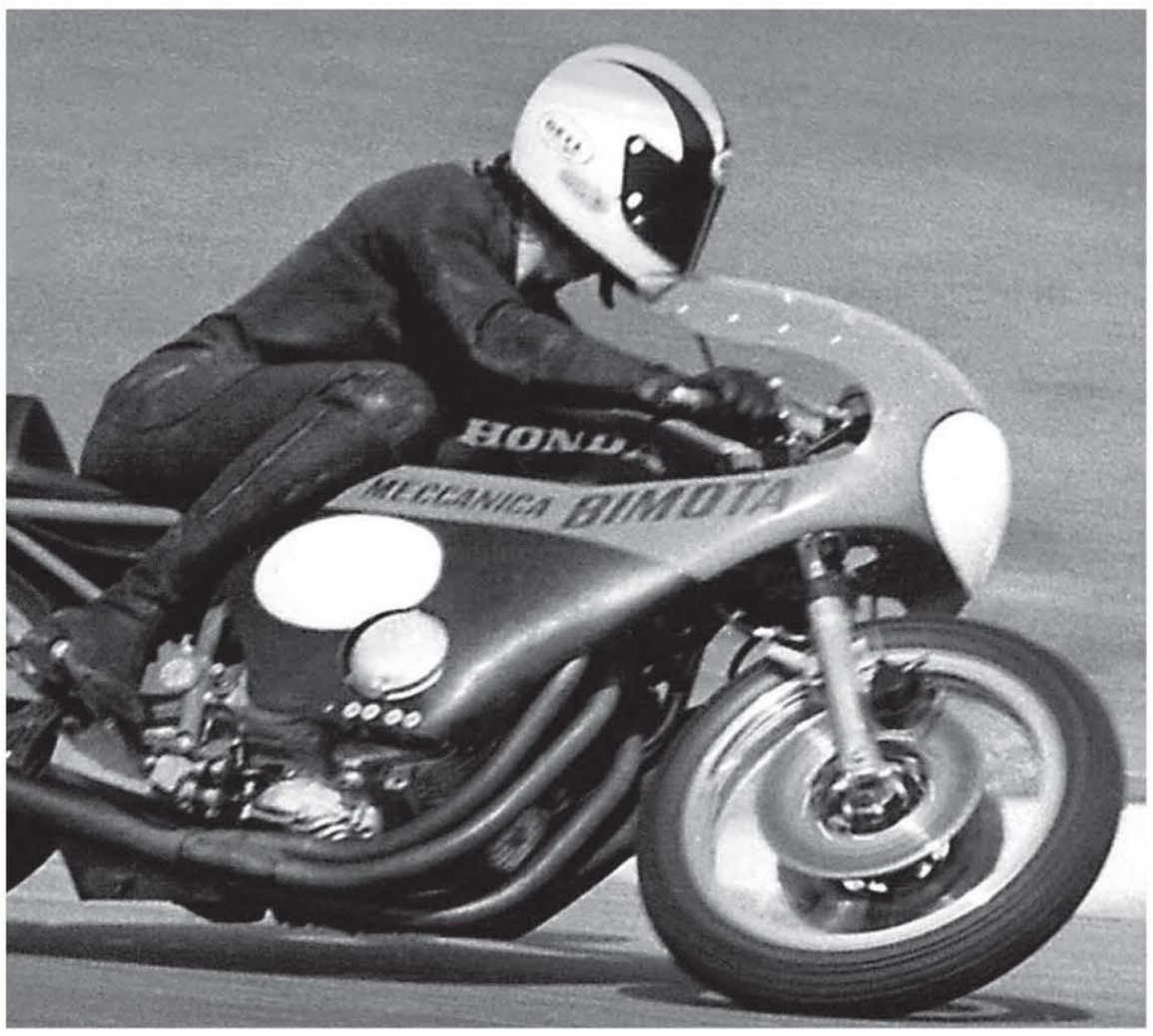
It hadn't been run for a number of years when he bought it, calling for some mild restoration work. "A respray was necessary because it was repainted twice and none of the colors matched," he said.

The engine needed work as well so Bob rebuilt the bike completely.

"My motorcycling experience started when I was a bit older – I was 26 when I bought my first bike, a Moto Guzzi," said Bob. "My interest remains in Italian bikes and racing machines. I have been vintage racing a Yetman-framed Ducati 250cc single for 18 years. Currently my street riding is limited to outings to bike meets and local rides, preferring day trips and an occasional overnighter."

He is involved with the US Classic Racing Association, a vintage racing club based out of NHIS racetrack in New Hampshire, and the Italian Motorcycle Owners' Club with its big meet in Sturbridge, Massachusetts each September.

FIRST PRODUCTION ROAD BIKE FROM THE GENIUS OF MRT



It's been said that if Massimo Tamburini had not crashed his Honda CB750 four at the Misano race track in 1972 the Bimota factory might never have been founded, and implying that one of motorcycling's greatest designers would not have continued to conceive iconic classics such as the Ducati 916 and MV Agusta F4.

Fact was that Tamburini had already been inspired by seeing the MV Agusta works bikes in action and had modified a roadgoing 600 MV four. The spill that cracked three ribs was the spur that he needed to design and build his first complete bike, the Honda 750-based HB1.

So it should have been no surprise that his chassis design was inspired by the red racers from Gallarate.

"It is true I was a great fan of MV Agusta, and when I designed the HB1 I got the inspiration from the MV Agusta bike that at the time was used in racing competitions," said Tamburini.

"The Bimota HB1 was the first bike I designed completely, and with a professional task. Before this bike I also worked on an MV Agusta 600, by strongly modifying its frame and increasing the engine displacement to 750cc. However, in that previous case, creating new bikes was still just a hobby for me, not yet a real job."

In the early 1970s, the Japanese factories had yet to make their potent superbikes handle well.

Tamburini's chassis design for the Honda engine was lighter and lower than the original. And looking like an MV Agusta must have led to the call for replicas, and the need to set up an organisation to build them.

And so with partners Valerio Bianchi and Giuseppe Morri (who with Tamburini each provided two letters to create the Bimota name) the factory was set up in Rimini and 10 HB1 machines were produced.

Bimota was one of a number of small operations in Europe offering better-handling chassis. I'd first seen the results of its efforts when I was reporting from the Grands Prix series in 1975. Johnny Cecotto cleaned up in the 350cc class with a TZ Yamaha using a Bimota frame and the same year Paolo Pileri raced a similar 250cc machine in the smaller class. Walter Villa raced works Harley-Davidson 250cc two-stroke twin using a Bimota frame with features that would later be used on its road bikes.

The factory's first production road bike, the 750cc Suzuki-powered SB2, was launched in 1977 and started a series of designs using Japanese four-cylinder engines. It was followed by the Kawasaki 900-powered KB2, 1000cc Suzuki-powered SB3 and more Honda-engined machines before Tamburini left the company in 1983. He joined Roberto Gallina's Suzuki GP racing team before moving to Ducati in 1985 when it was owned by the Cagiva group, which later acquired the MV Agusta marque.

Tamburini remains managing director of the Cagiva Research Centre in San Marino where he is working on exciting new projects for MV Agusta, which was bought by Harley-Davidson in July, subject to US regulatory approval.

"At the present time, we are dealing with the development of the F5 and the new Brutale," he said. "It is about time for a new F4, and we are working to realise it."

150mph top speed. Weight was 433lb dry, a huge 60lb less than the GS750.

But if I'd expected this SB2 to be a handful I was mistaken. Nipping along the back streets of Douglas to reach the TT course the bike zipped through the gears smoothly as the howl bounced off the buildings. It was a doddle, and I daren't reveal what the speedo showed as I crossed the roundabout at Quarter Bridge and set off for Bradden. Before I'd reached the left-right at the bridge the Suzuki motor had hit the promised 11,000 through the gears but I had to check the speed through road works. Beyond the 30mph section at Union Mills I gave the Bimota its legs and it just sang along at what seemed like a comfortable cruising gate, but what the speedo showed was well over a ton.

I tucked in, moulding myself into the sculpting of the bodywork. The footrests were amazingly narrow, thanks to the pinching of the swingarm and neat attachment of the foot anodized-alloy controls to spars inside the swingarms. Chinning the tank behind the fairing I still had a great view of the road as it snaked ahead. For the time, the SB2's stability was uncanny.

At Glen Vine, the TT course was smooth and uncluttered and climbs to a crest just before The Highlander Inn. At the crest the front went light and the revs picked up more quickly, the speedo showing 120mph as I flashed past the Inn before it was necessary to knock it back for the left-right at Greeba Castle.

A more demanding test of the Bimota's handling came beyond the blind bends at Laurel Bank and Glen Helen. While at modest speeds it's nimble, the rear end is a little harsh, and this was borne out on the bumpy surface beyond Handley's. But the handling was nigh spot on as I flicked the bike through the high speed bends at Bishopscourt before ambling over Ballaugh Bridge.

Quarry Bends were even more demanding. Most racing bikes wiggled their rears as the bumps

SUCCESSORS TO THE SB2

Three years after the SB2 was launched, a revised version with less radical styling appeared in 1980 callled the SB2/80 and inevitably it was followed by a model to accept Suzuki's GS1000 engine, the SB3.

UK agent David Dixon adapted one of the 998cc dohc fours for the first SB3 in the UK which I took for a spin through Surrey's twisty lanes.

With about the same peak power as the SB2 I rode in the Isle of Man, the SB3 had more grunt but was much more relaxed. The taller fairing also helped provide a more comfortable riding position.

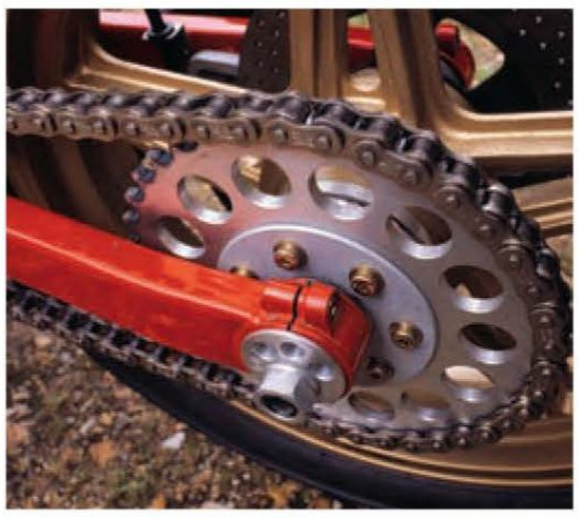
Racing success continued with Jon Ekerold winning the 1980 world 350cc championship on a Bimota-framed Yamaha two-stroke twin.

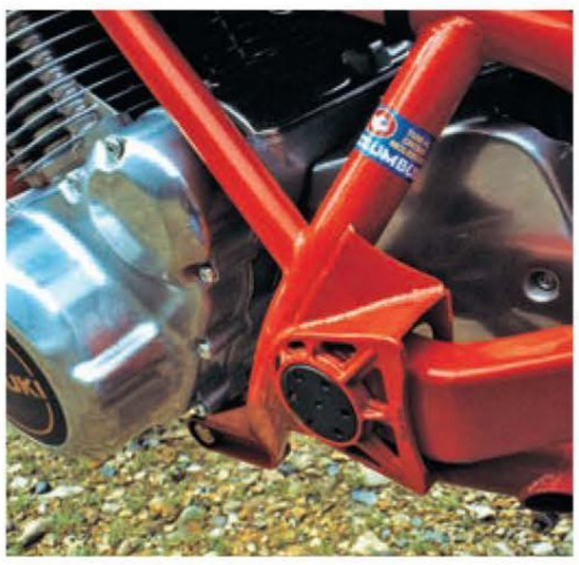
More Honda-engined Bimotas appeared, including the HB2 powered by a dohc CB750F engine and using a perimeter-style space frame, a similar version of which was adopted by Yamaha for its FJ1100. This was followed by the same chassis housing the Suzuki-powered SB4 and Kawasaki-powered KB3.

After Tamburini, the factory, in 1983, Bimota hired designer Federico Martini from Ducati which provided a connection that resulted in the DB1 V-twins.

The advent of aluminium alloy beam frames arrived with Martini's design for four-cylinder FZR engines from Yamaha including the YB4, YB6 and YB6 Exup culminating in a world TT F1 championship title on a YB4 in 1987 for Virginio Ferrari.

More information from
www.bimota.it
www.bimota-enthusiasts.com
www.bimotaforum.co.uk





were hit under full power and the Bimota did the same, but never felt anything but secure.

The climb out of Ramsey is a good measure of power delivery and exiting the hairpin the Bimota's front wheel fought back over the bumps and lifted off the deck as the engine hit what was a more obvious power band. The Mountain was taken at a comfortable 120mph and on the smooth surface the bike could be confidently pitched from apex to apex. Beyond the Bungalow, the speed never dropped below 100mph: I could see well ahead and it was safe to straighten the series of curves. Then at Keppel Gate I could see down to the Creg and nailed the bike, hitting the bump in one brief ecstatic moment at 110mph, with both wheels off the ground.

Back in Douglas, Bill Smith, who even by then could boast dozens of TT replicas, provided his own verdict on the bike. He didn't like the rear suspension, which with his extra weight was too soft, or the riding position, which could have been improved by raising the handlebars by about two-and-a-half inches.

By the time the bike was prepared for the TT it had been fitted with a 944cc full-race engine that was timed at the MIRA proving ground at 145mph. Fujio Yoshimura, son of the fabled Pops, came over for the TT and fitted a special cam chain tensioner on the eve of the race.

Problems in practice had surfaced when it was found that the alloy fuel tank inside the bodywork wasn't large enough to last two laps. A smaller additional tank was grafted into the seat tail and connected with an additional tap.

In the race Smith hit the bump at the bottom of Bray Hill and the bodywork's rubber mounts let go, allowing the rear to touch the tyre and overheat the seat. But all ended when the cam chain tensioner broke, allowing the pistons to hit the valves, which as Dixon recalls, lent credence to Smith's remark that "...it felt rough, so I pulled in...", leaving the Glencrutchery Road obliterated in a cloud of oil smoke...

By Japanese standards, the SB2 was produced in tiny numbers. Records show that Bimota made 140, which was high by its standards. That now puts the SB2 among some of the rarest machines ever produced and, coming from the pen of a master, worthy of classic status.

SPECIFICATION
BIMOTA SB2

MODEL	Bimota SB2 (Suzuki GS750)
ENGINE	Suzuki air-cooled 8-valve inline four
CAPACITY	843cc (69 x 56.4mm)
VALVE OPERATION	Double overhead camshafts
COMPRESSION RATIO	10.5 to 1
LUBRICATION	Wet sump
IGNITION	Coil and contact breakers
CARBURATION	Four Mikuni 29mm smooth-bore (26mm)
PRIMARY DRIVE	Gear
PRIMARY RATIO	99/46 (2.152)
CLUTCH	Wet multiplate
GEARBOX	5 speed
INTERNAL RATIOS	1st 2.571; 2nd 1.777; 3rd 1.380; 4th 1.125; 5th, 0961
FINAL DRIVE	⅝ x ⅜in roller chain
FINAL DRIVE RATIO	41/16 (41/15)
OVERALL RATIOS	14.2, 9.8, 7.6, 6.2 and 5.3 to 1
PEAK POWER	95bhp at 10,500rpm (68bhp at 8500rpm)
FRAME	Bimota duplex steel tubular space type
FRONT SUSPENSION	Ceriani telescopic fork legs in Bimota offset yokes
REAR SUSPENSION	Pivoted rear fork with Corte e Cosso single shock,preload adjustment
FRONT WHEEL	Bimota light-alloy, 2.15 x18in
REAR WHEEL	Bimota light-alloy, WM4 x18in
FRONT TYRE	Michelin 3.50x18 S41 PZ2
REAR TYRE	Michelin130/80H18 M48
FRONT BRAKE	Brembo 11in diameter dual discs
REAR BRAKE	Brembo 10.2in diameter disc
ELECTRICAL SYSTEM	12v alternator, 50/40W headlamp, starter motor
BATTERY	12v 14Ah
FUEL TANK	3.5 gallons
WHEELBASE	1392mm (54.8in)
SEAT HEIGHT	750mm (29.5in)
CASTOR ANGLE	64 degrees
TRAIL	114.3mm (4.5in)
CLAIMED WEIGHT	197kg dry (433lb) [492lb]
SPEEDS IN GEARS	56mph, 81.6mph, 104.7mph, 128.3mph, 150mph, at 10.500rpm

MIGHTY MIDDLEWEIGHTS

When the Kawasaki GPz550 and Honda CBX550F were launched in 1982 they were heralded as breakthroughs in high-performance middleweight design. John Nutting recalls his MIRA testing sessions from the period.

Originally printed in the July 2003 issue of *Classic Motorcycle Mechanics*

The Honda came out best on top speed.

CHINNING tank of the Kawasaki GPz550, I fired the bike towards the end of the MIRA timing straight more than half a mile away. The speed testing session had started out on a cold February morning routinely, but ended with the realisation that this bike represented the start of a new era in high-performance middleweights.

At first, as the four cylinder motor shrieked through the lower gears, it felt strangely undramatic. Then, after I snicked into top gear at nearly 110 mph and with plenty more bitumen to use up, it became obvious that the engine just wanted to rev and rev.

A strong tail wind was helping to provide the thrust and the little red Kawasaki's engine howled through the red line at almost 10,500 rpm, with the speedo showing 140 mph. The timing equipment recorded a figure less that this but it was still well above 130 mph. It was the fastest-ever speed recorded by a middleweight and offered the performance we'd been accustomed to from 750s.

The press raved about the Kawasaki's speed and handling. Yet it was just the start. Three months later I tested Honda's CBX550F four, and it was even faster than the Kawasaki. Likewise, Honda's new 550 was lithe and potent. And it tore up the conventional rules that equated capacity to power.

The year was 1982. Bikes such as the CBR600 Honda which had heralded a revolution in both design and performance were still four years in the future. But the foundations were being laid.

Kawasaki had already showed how a smaller capacity machine could upset the superbike apple cart when its Z650 appeared in 1976, followed by its even better derivative, the Z750.

The GPZ550's beginnings were in 1979 when the elegant but understated Z500 appeared using 499cc variation on Kawasaki's aircooled four-cylinder architecture with double overhead camshafts that operated the valves through buckets, the clearance being adjusted by replaceable shims. A year later it was bored out to 554cc, developing 54 bhp.

But the factory really caught riders' attention when it launched the GPz sports range in 1981. This featured blazing red paintwork, black engine covers and bikini fairings for the 550, 750 and fuel-injected 1100 models, backed up by updated cycle parts including items such as adjustable air forks with Teflon-coated bushes and needle roller bearings for the rear swingarm.

The GPz550-D1 of 1981 was the class leader, its free-revving engine turning out its 58 bhp peak power at 9000 rpm, enough to

Words/Pictures: John Nutting

The start of a new era in high speed middleweights.

almost reach 120 mph flat out. Weighing in at a claimed 439 pounds dry and with a wheelbase of 55 inches it was compact and nimble: the epitome of sports motorcycling in the early Eighties.

Competition hots up

BUT it is more than likely that Kawasaki was aware that there would tough competition on the way from Honda for the next model year. So Kawasaki's engineers completely revamped the bike for 1982 with a revised engine and a chassis that drew from the factory's world road racing title successes in the 250cc and 350c classes in 1981.

While the basic duplex tubular steel frame was retained, the front leading-axle fork geometry was revised with a 62.5 degree steering head angle; the head bearings now used taper rollers; while the suspension springs - with a revised rising rate - were augmented with air pressure, the legs being connected.

At the rear the conventional swingarm with twin shocks was completely replaced with a Uni-trak system similar in design to that on the KR500 racer campaigned by Kork Ballington. A triangulated fork, suspended by a single vertical shock, connected with a rising rate linkage that increased wheel travel from 120mm to 140mm.

Brakes were virtually unchanged with twin front and single discs with floating single-pot calipers. Kawasaki had already cracked the wet-weather problem by using brake pads with metallic content and discs with asymmetric perforations. Unsprung weight was reduced by using five-spoke instead of seven-spoke alloy wheels.

Although the agility of the GPz550 might have been dulled by its increase in wheelbase by all of two inches from 55.1in to 57.1in, the bike's handling was sublime in almost all conditions. Adjusting the pressure in the front fork and the preload on the rear shock was tricky but rewarding, providing adequate firmness for sporty riding without reducing ride quality.

As editor of *Which Bike?* at the time I reported: "The GPz550 is a remarkable machine and can be pitched confidently into the sort of battered bends which might have experienced riders gripping the 'bars of Italian super-handler in white knuckle terror.

"The forgiving action of the Uni-trak is immediately obvious, but that's only part of the story: increasing the

1982 550 fours test data

All figures compiled at Motor Industry Research Association's proving ground, Nuneaton, Warks.

MODEL:	Kawasaki GPz550	Honda CBX550F
DATE OF TEST:	27 Feb 1982	10 May 1982
CONDITIONS:	cold, tail wind	na
MEAN TOP SPEED (MPH):	122.74	123.44
BEST ONE-WAY (MPH):	132.69	127.69
MEAN NORMALLY SEATED (MPH):	111.50	113.04
STANDING QUARTER-MILE: (MEAN, SECS/MPH)	12.98/102.71	12.71/103.92
SPEEDO ACCURACY, ACTUAL MPH AT INDICATED: 30, 50, 70	27.6, 45.7, 66.5	27.5, 46, 66.9
TEST WEIGHT (1GAL FUEL):	410lb	426lb
OVERALL TEST MPG:	54mpg	44mpg

The Honda felt tiny with 54.3 inch wheelbase and 18 inch tyres.

wheelbase has added some welcome stability in cornering with barely any extra leverage at the handlebar. The steering is neutral and the balance of the bike so good you can explore the limits of the Bridgestone Mag-Mopus tyres in the wet with an abandon normally associated with lightweights."

For general day-to-day use, the 550's upright riding position would be described today as retro, with the footrests positioned just below the seat nose complementing the raised handlebars, which were bolted to the top of the fork legs. As an owner, I would have taken a file to the mounts to reposition them to give a more tucked in feel. For high speed cruising, comfort was good, a tingle from the engine only slightly marring the feel.

Increased power

PEAK power of the eight-valve 554cc (58 x 52.4mm) engine was upped from 58 bhp at 9000 rpm to 61 bhp at 9500 rpm by using a new cylinder head casting that enabled the opening up of the inlet port diameter from 25mm to 28mm and lengthening the valve timings. While this also lifted the peak torque revs to 8500 rpm, any peakiness was mitigated by the adoption of constant-velocity TK carbs with 26mm chokes. Overall gearing of the six ratios was unchanged.

"But engine flexibility isn't compromised by its extra power," I reported. "It pulls lustily from under 2000 rpm in top gear and provides strong torque all the way through the range. And with six speeds to play with there are always ample reserves to launch this middleweight virtually at will."

Handling and performance always benefit from weight reduction but to my surprise, Kawasaki didn't exploit the cuts it had made with the GPz550H1. Although it claimed that dry weight had been reduced from 199.5kg (439lb) to 192kg (422lb), I measured the bike on a weighbridge with a full four gallons at 434 lbs, suggesting that the dry weight was really 402 lb.

This, along with the higher peak power, must have been a key input to the remarkable performance figures returned by the bike at MIRA's proving ground.

With the help of that tail wind I clocked three top speed runs at more than 130 mph, the best being 132.69 mph with the engine revving at 10,500, well into the red zone starting at 10,000. This was with the mirrors removed (a safety measure to improve stability) and the rider flat on the tank.

Of course the bike had to contend with a head wind in the opposite direction but it still managed 112.79 mph, giving a mean two-way speed of 122.74mph. Riding normally, the two-way average was 111.5 mph.

Acceleration was no less stunning. Downwind I clocked three consecutive standing quarter-mile runs between 12.67 and 12.86 seconds while in the opposite direction I made five between 13.29 and 13.50 seconds, giving a two-way average of 12.98 seconds with a terminal speed of 102.7 mph.

What was also surprising was that this performance came without any downside in fuel consumption. Even during the MIRA testing sessions the consumption never dropped below 46.6 mpg and including some cruising mileage during which the bike clocked 61 mpg, the overall consumption was 54 mpg. With its four gallon tank that gave a range of about 170 miles before the liquid-crystal display in the instruments started to flash.

1982 550 fours specification

MODEL	Kawasaki GPz550D1 (GPz550H1)	Honda CBX550F
ENGINE	Aircooled four	Aircooled four
CAPACITY	554cc (58 x 52.4mm)	573cc (59.2 x 52mm)
VALVE OPERATION	Dohc, 2-valves per cyl	Dohc, 4-valves per cyl
COMPRESSION RATIO	10 to 1	9.5 to 1
LUBRICATION	Wet Sump	Wet sump
IGNITION	Electronic inductive	Electronic inductive
CARBURATION	Four 22mm TK (Four 26mm TK CV)	Four 30mm Keihin CV
PRIMARY DRIVE	Inverted-tooth chain and gear	Inverted-tooth chain and gear
PRIMARY RATIO	2.93:1	2.565: 1
CLUTCH	Wet multiplate	Wet multiplate
GEARBOX	Six speed	Six speed
INTERNAL RATIOS	2.57, 1.78, 1.38, 1.12, 0.961 & 0.851:1	2.50, 1.714, 1.333, 1.074, 0.931 & 0.821:1
FINAL DRIVE	Chain	Chain, RK50M
FINAL DRIVE RATIO	2.37:1	16/45, 2.81:1
OVERALL RATIOS	17.9, 12.4, 9.6, 7.8, 6.7 & 5.93:1	18.04, 12.36, 9.61, 7.75, 6.72 & 5.92:1
PEAK POWER	58 bhp at 9000 rpm (61 bhp at 9500 rpm)	62 bhp at 10,000 rpm
PEAK TORQUE	4.9 kgm at 8000 rpm (4.9 kgm at 8500 rpm)	4.7 kgm at 8500 rpm
FRAME	Duplex cradle steel tube	Duplex steel tube cradle
FRONT SUSPENSION	Telescopic leading-axle fork, 180mm travel	Telescopic fork, air-assist, anti-dive
REAR SUSPENSION	Steel swingarm, twin shocks, 120mm travel (triangulated steel swingarm, single shock, 140mm)	Light-alloy swingarm, single shock, air-assist.
FRONT WHEEL	Cast alloy, 19in dia	Comstar, MT2.15x18in dia
REAR WHEEL	Cast alloy, 18in dia	Comstar, MT2.15x18in dia
FRONT TYRE	Bridgestone 325H19 tubeless	Dunlop F11, 360H18 tubeless
REAR TYRE	Bridgestone 400H18 tubeless	Dunlop K527, 410H18 tubeless
FRONT BRAKE	226mm dual disc Single-piston calipers	Enclosed 230mm dual disc Dual piston calipers
REAR BRAKE	226mm single disc	Enclosed 230mm disc
ELECTRICAL SYSTEM	12V alternator, 60/55W headlamp starter motor	12V alternator, 60/55w headlamp, starter motor
BATTERY	12V 12Ah	12V 12Ah
FUEL TANK	18.5 litres, unleaded	17 litres, unleaded
DIMENSIONS	Wheelbase 1400mm (1,450mm), seat height 740mm (750mm), castor angle 62.5 deg, trail 110mm, weight claimed 199.5kg dry (439lb), 192kg (422lb)	Wheelbase 1380mm, seat height 790mm, castor angle 64 deg, trail 97mm, weight claimed 184kg (405lb)

The Honda's engine drew on design ideas from the CBX-6 and 750/900 fours.

Kawasaki and Honda 550 shoot-out

Even during speed testing the GPz returned 46mpg.

Spectacular machine

KAWASAKI'S GPz550H1 was a spectacular machine. It had to be, because hot on its tail was Honda's CBX550F. Since the Seventies, Honda hadn't done much to improve its middleweight fours, production of the CB400F having stopped before 1980 while the eight-valve CB550 had evolved into the CB650.

But a better 400cc model for the domestic market was needed, so a pair of similar machines was developed that would also serve the need of plugging the gap in the range for a 550.

Even as a 400cc machine the new platform was competitive, the dohc engine drawing upon design ideas that had been incorporated into the CBX six and the 16-valve 750cc and 900cc fours introduced in 1978. That made the CBX550F even more potent because the package was so compact.

Like the Kawasaki, the Honda's four aircooled cylinders were across the frame with the drive to the double overhead camshafts being by chain between the centre two pots. Power was fed through an inverted-tooth chain to a countershaft and gears to the clutch and six-speed gearbox. Each cylinder's four valves were operated through followers with clearance adjustment by screws.

Internal dimensions were 59.2 x 52mm, giving a swept volume of 573cc. Breathing through four 30mm Keihin CV carburettors and with a compression ration of 9.5 to 1, the CBX550F developed 62 bhp at 10,000 rpm, peak torque coming in at 8500 rpm.

Power delivery wasn't quite as linear as the Kawasaki's, but the 550F would pull cleanly and smoothly from a tickover. The best throttle response was above 6000, just above a slight dip common to many other machines that was engineered to accommodate noise regulations. Above that the bike would steam enthusiastically to 8000 rpm (100 mph on the clock) and towards the 11,200 rpm red line.

So the motor performed, but the style of the bike was just as appealing. It felt tiny, with a 54.3in wheelbase and 18-inch wheels front and back, so much so that it immediately appealed to shorter riders and women. But the ergonomics were right too with nicely placed footrests and swept back bolt-on handlebars that shared much with the CBX six, using lightweight alloy components and sensible cable runs. So although you sat astride the bike with both feet flat on the deck you weren't folded too tightly when riding the bike.

Chassis detailing was appealing too with a cast-alloy rear fork and an air-assisted single shock operating through a linkage, a forerunner of the Pro-link systems currently used on Honda's sports bikes. Up front the telescopic fork also had air-pressure assistance plus the novelty of anti-dive on one of the legs. The idea of this was that softer suspension could be used without the rider suffering from instability under heavy braking.

Controversial fittings

ANTI-dive was linked mechanically to the front brake which, like the rear stopper, was one of the more controversial features of the 550F. Having the appearance of huge racing style drum brakes, these were an attempt at providing more reliable performance, regardless of being wet or dry.

They used cast-iron ventilated discs which floated on peripheral mounts, smaller versions of the rim brakes now used by Buell, that were gripped by dual piston calipers. I thought that along with the alloy Comstar wheels, they

Photography by Jon Bubbin

Kawasaki's GPz550 sets new performance standards for the class

Find somewhere quiet and comfortable, sit down, relax and prepare to have your ideas about superbike performance blown into the weeds. The speeds we normally expect from machines these days are just under the ton for a two-fifty, ton-ten for a three-fifty or four-hundred, five mph more for the five-hundreds, just over ton-twenty for the 750cc fours and 130mph or more for the thousand 1,000cc superbikes. This is a hierarchy that has developed over the past few years and didn't appear to be open to attack in the near future.

But the new breed of five-fifties look certain to upset the applecart. And the first one to get into our sweaty hands, Kawasaki's Unotank GPz550, confirms this. Already this was a bike with an admirable set of credentials: snappy acceleration, sharp handling and flashy looks stemming from the generic-red GPz finish also common to the fuel injected GPz1100.

Now this is where you brace yourself for the seemingly impossible. We had expected the latest GPz550 to be pretty good and we outlined the impressements as we then knew them in the January issue. But the test bike far exceeded our expectations. Even the first few miles confirmed that this bike was the start of something really fresh in motorcycling - a fast sports bike with no drawbacks. Damn it, the GPz550 was quick and handled well, but it felt more refined, too!

Just how fast the 550 turned out to be was impossible to predict with any certainty, but gut reactions showed that redlining the engine to 10,000 in the gears gave the impression that it would give 750cc bikes a run. At the test strip, all was revealed, however. Taking the average of two opposed runs to cancel out the effects of wind, the GPz550 clocked just under 123mph and in one freak run with a tail wind the bike shot up to 10,400rpm in top gear to record almost 133mph (with 140mph on the clock)! Those figures wouldn't shame a Z750 four, let alone a 550, and the average figure is about eight mph up on last year's bike.

The acceleration is stunning too. Just dipping into the twelves, the 550 clocked an average 12.98 seconds for the quarter mile with a terminal speed of 102.7mph. That's better than Kawasaki's first 650cc fours and puts the GPz550 way ahead of the current 550 opposition.

You'd expect such performance to be accompanied by a highly-strung character and finicky behaviour. But engine flexibility isn't compromised by its extra power; it pulls lustily from under 2,000rpm in top gear and provides strong torque all the way through the range. And with six speeds to play with there are always ample reserves to launch this middle-

IMPOSSIBLE DREAM

40 May Which Bike?

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"The 550 that I tested in May 1982, three months after the Kawasaki, was the unfaired model which I thought would be a better comparison with the GPz."

looked great - until I attempted to disassemble the front unit to find out how it worked. It took ages, which is why they were neglected by riders, who usually found there was something wrong when the discs wore out and fell apart.

That was still in the future. The bike's handling was intoxicating enough to encourage all kinds of heroics with generous clearance and, provided the air pressure in the rear shock was pumped up to about 40psi to minimise wallowing, precision roadholding.

With a steep steering head angle for the time of 64 degrees, the 550F provided a fine handling balance between stability and response that like some other scratchers' machines was demonstrated by a mild resonant flapping of the steering as you slowed through 40 mph. Partly aggravated by the weight of the front brake, it was a characteristic that you didn't notice much of the time.

The 550 that I tested in May 1982, three months after the Kawasaki, was the unfaired model which I thought would be a better comparison with the GPz.

And so it proved. Gearing was almost spot-on with the peak power revs of 10,000 equating to 123 mph. And that's what the bike did with me flat on the tank at MIRA. The best one-way speed was 127.69 mph which, with an opposing run at 119.19 mph, gave an average of 123.44 mph. Maximum speed with a normal riding stance was also slightly quicker than the Kawasaki at 113.04 mph.

The Honda just ripped through the quarter mile, almost reaching peak power in fifth gear at 103.9 mph when tripping the lights at 12.7 seconds, more than a quarter of a second quicker than the Kawasaki.

This was despite an all-up weight of 448 pounds, some 14 pounds more than the Kawasaki. This and the more peaky nature of the Honda may have contributed to the heavier overall fuel consumption of 44.2 mpg that included the testing. The cruising best of 55 mpg offered a range of 160 miles before reserve.

550 F2 model more popular

IT'S NO surprise that the versatile 550F2 model with its stylish frame-mounted top fairing was more popular, offering higher cruising speeds at the expense of outright top speed.

But after a few thousand miles the appeal of the bike wore off. Like most Hondas, the 550F suffered if servicing was neglected. Honda recommended that oil filter be changed every 4000 miles but experience has shown that oil change intervals of 2000 or less improve reliability. Attention must also be paid to the cam chain, which has a problematical adjuster.

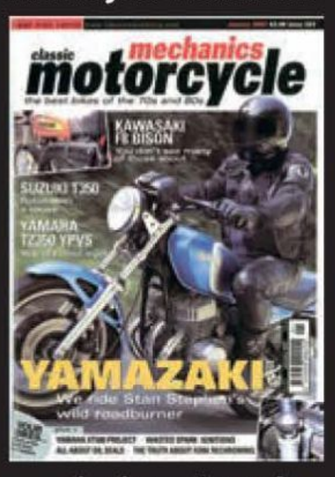
The rear shock and its associated linkages required careful attention to give their best, as on the Kawasaki. As with the front brake, which is better replaced with a conventional twin disc set up, aftermarket versions are a more sensible option.

Both the GPz550 Kawasaki and the CBX550F Honda were exciting entrants to the sports market. But while the Kawasaki was further improved with more swoopy styling and a more powerful 65 bhp rubber mounted engine, the Honda languished, to be replaced in 1986 with the CBR600 and its watercooled 85bhp motor and all-enclosing bodywork. And so started another chapter in sports machine design.

How John reported the GPz's performance in 'Which Bike.

Above left: Later GPz550 with 'swoopy' styling.

Originally printed in the January 2007 issue of *Classic Motorcycle Mechanics*



classic motorcycle mechanics

TIME BOMB

When Kawasaki's Z1000 went soft, the factory's answer was the Z1R. But the Z1R wasn't enough for some, who went over the top and turbocharged it. John Nutting tested both, but wasn't impressed.

Hard though it seems to believe, Kawasaki's Z1 – the definitive muscle bike of the era – had been emasculated within four years of its launch in 1972.

I know, because at the MIRA proving grounds in the Midlands I had tested for the weekly paper Motor Cycle each new four-cylinder Kawasaki almost as it came off the production line in Japan. And each one had become progressively slower. Gone were the days of the original fire-breathing Z1 with its searing 130mph-plus top end and blistering acceleration.

When I tested the Z900 in 1975 it clocked just over 125mph. Two years later the Z1000 was even slower, unable even to break 125mph. And it wasn't just the performance that had been dented: gone were the original bike's sexy four pipes, replaced by bland twin silencers. From behind, the Z1000 could be any one of a number of Japanese bikes.

Nowadays that change in the specification is not a concern because it's possible to tune a Kawasaki in any way you want. Pick the right parts and you can have a 'stock' Z1000 that pumps out 80bhp at the rear wheel with ease.

But back in the 70s I found the softening of the Z1000's character a real disappointment, and it couldn't have escaped the attention of the Kawasaki top brass who, mindful of the impact that Honda's CBX, Suzuki's GS1000 and Yamaha's XS1100 might have on its sales, commissioned a makeover for the 1978 model year.

The result was the Z1R, which turned out to be more of a styling exercise than a concerted effort by the factory to restore the big four's reputation as the hottest bike on the block.

Gone was the rounded Japanese look, replaced by angular bodywork, including a handlebar fairing, that would have done justice to a

European design house. Bringing the bike right up to date, it used seven-spoke cast alloy wheels and a four-into-one exhaust system. The Z1R couldn't have been more transformed, with a combination of cafe racer and race bike technology. Detailing included a stylish lockable tank cap the size of a cigarette case. Inside the fairing, which was more than just an ornament, the 160mph speedo and 12,000 rpm tacho were augmented by a fuel gauge and ammeter. Mounted in delicate alloy castings was a console for the self-cancelling turn signals and the front brake master cylinder, connected to the lever by a cable.

Removing the lockable lift-off seat revealed the tool kit and air-filter and the detachable kick-start lever.

Despite the conventional handlebar, the Z1R proved to be a formidable road burner, the fairing enabling comfortable ton-plus cruising speeds, the refined engine belying its increased power output.

Apart from a tougher black epoxy finish for the cases the double-overhead-cam four-cylinder 1015cc unit was unchanged from the Z1000A1, but the Keihin carburettors were increased in size to 28mm, the same as the original Z1. This, along with the revised exhaust system, raised the claimed peak power from 83bhp to 90bhp at 8000rpm.

But while the Z1R was quicker than the previous year's model, the changes failed to restore the blistering speed of the first Z1. Tested at MIRA's proving ground on a frosty day in February 1978, the best two-way mean top speed I could get was 127.16mp h, some 3mph down on the Z1 I tested five years earlier. Gearing was the same as the A1 model with a 33-tooth rear sprocket, which although reducing the revs for top-gear cruising prevented the engine from reaching 8000 in top.

WHY TURBOCHARGE?

All engines that burn fuel in their combustion chambers are essentially air pumps. The more air and fuel that an engine uses, the more power it develops. The power is developed from the work done by the expansion of the heated gases as the fuel burns.

For normally aspirated engines, the amount of air they can pump is limited by atmospheric pressure, which is around 14psi at sea level. One way of increasing the flow and therefore the power, is to increase the engine's swept volume. Another is to raise the engine speed. But there are limits, in each case set by fluid losses in the porting or the mechanical limits of the components. That's why in a piston engine the power rises to a peak and then tails off. It can't draw more air through its intake ports than can be pumped in by air pressure.

Turbines are a separate family of engines that because they are rotating rather than reciprocating are less limited by mechanical losses. They still use the basic Otto cycle of induction, compression, combustion and exhaust but because they are not positive displacement units, as with piston engines, don't run well at low speeds. They are better suited to high flow rates and constant speeds.

The compressor used in a turbine, such as used on an aircraft's turbo-prop or jet engine, can just as easily be applied to compress the intake air to increase flow in a piston engine. But, unlike a supercharger, a positive displacement device, the compressor must be driven at higher speeds to produce any useful pressure.

One way is to use a turbine powered by the piston engine's exhaust gases. Even after the combustion gases have been exhausted they are still expanding and can do more work. Originally, exhaust turbines were connected to a compressor to reduce fuel consumption or compensate for loss of air pressure at altitude for piston-engined aircraft. But as materials improved they were used to boost power for road vehicles.

The lack of top-end performance might have been acceptable had the handling been improved. Until the introduction of the Z1000J in 1981, the big Kawasakis suffered from poor steering characteristics that couldn't be dialled out by suspension changes. Along with the Z1R's change to cast alloy wheels, the front diameter was reduced from 19in to 18in, taking a wider 350x18 tyre. At the same time the rear fork was revised to accommodate four needle-roller pivot bearings, controlled by Kayaba shocks with twin springs and, along with the front fork, softer spring rates.

But the Z1R suffered from a range of handling flaws. At moderate speeds the steering was light but top heavy. Above 60mph you still had to apply effort to the handlebar to hold a line, or use weight transfer, and the rear shocks failed to control the rear end, allowing gyrations that were completely out of place on a bike costing nearly £2000 at the time.

But that wasn't all. The dual front discs still didn't work in the wet, despite having been drilled, and faded during top speed tests. And the fuel consumption was poor, ranging from 25 to 46mpg, figures that were made more awkward by the small 2.9-gallon tank that gave a range of 115 miles at best, or just 90 miles if you topped up right after switching the reserve tap.

I wasn't much impressed by the Z1R.

FROM BIKES TO CARS, AND BACK

Since 1978 Russell Savory has built a strong reputation as one of the UK's top bike tuners and engine developers, being involved with a number of racing teams such as Loctite Yamaha in the 80s and many TT winners such as Brian Reid. He produced a number of special VTRs, VFRs and CBRs for Honda's 50th anniversary year and has advised Honda's Frankfurt headquarters on engine development.

Savory tuned the CBR900 FireBlade that Jim Moodie won the 1998 TT Production race on, with a lap record of more than 120mph. The ideas, along with many others, were incorporated into the 170bhp, 174kg Evo-Blade using a frame from Harris Performance, with whom he has had a long relationship. Savory went on to run the Honda Motopower Supersport racing team in the UK.

About 15 years ago he developed a two-litre V-eight sports car engine. "It made 304bhp the first time we put it on the dyno," he recalls. But the project was "put on the shelf" for a decade.

Now that engine has been revived as the RST-V8 and will be used in its 485bhp form as power for the lightweight Caparo T1 sports car giving 1000bhp/tonne designed by Gordon Murray of McLaren fame. Savory is licensing the engine to Roush, a big US-based tuning equipment manufacturer. That leaves him with time to get back into bikes, he says, but can't say at the moment how that will happen.

KAWASAKI Z1R/Z1R TURBO PERFORMANCE

Model:	Kawasaki Z1R	Kawasaki Z1R Turbo
Date of test:	16 Feb 1978	Sept 1978
Location	MIRA	Santa Pod
Mean top speed (mph)	127.16	–
Best one-way (mph)	129.69	158mph (est)
Mean normally seated (mph)	116.90	–
Standing quarter-mile: (mean, sec/mph)	12.65/106.26	11.40/123.80 (one-way)
Speedo accuracy, actual mph at indicated:		
30	27.4	na
50	45.8	na
70	64.1	na
Test weight (1 gallon fuel):	552lb	552lb
Overall test mpg	40.9	42.0

TURBOCHARGERS TO THE RESCUE

Hope of boosting the Z1R's image was at hand though, in the form of a newly-developed technology: turbocharging.

Already established as the hot tip for boosting car performance, turbocharger kits were being offered by American Turbo-Pak. These kits used modified Rajay 370F40 turbochargers with thicker heat shields between the turbine and compressor and a better centre bearing to improve lubrication.

In the US, Alan Masek, a former Kawasaki marketing director, formed Turbo Cycle Corporation and assembled a number of Z1RTC machines using the kits, selling them through selected Kawasaki dealers. Giving a lie to what was in store, the bikes were sold without a warranty.

This was a wise move, because although the Z1RTC was, according to reports at the time, a terrifyingly fast machine to ride, owners were tempted to make them even faster by opening up the waste gate. This valve controlled the boost pressure to about 8psi above ambient, but being adjustable was often too much of a temptation. Power delivery was even more rampant, with the frequent result that the crankshaft, normally a pressed-up unit that for performance work needed welding, would twist.

Sales weren't great in 1978, so the remaining Z1RTCs were repainted by Turbo Cycle Corp in black with red, orange and yellow graphics which, along with more stylish exhaust plumbing did the trick. But no more were made.

At the same time, Russell Savory of Hertfordshire-based RS Performance was offering a similar kit and provided a Z1R Turbo to test through the Kawasaki dealer in nearby Enfield.

This was just like the Z1RTCs produced in the US but with smarter red paintwork finished with white pinstriping. A chrome-plated header connected the exhaust ports to the Rajay turbocharger mounted where the carburettors usually were, while a huge tail pipe swept under the left footrest. Under your right knee a round air filter fed a single 40mm-choke Bendix carburettor with an accelerator pump. This used a butterfly valve because the pressure draw would seize up conventional slide carbs.

To provide the necessary higher fuel flow, an adjustable electric fuel pump sat under the seat. Oil feed for the turbocharger's plain bearing was bled from the engine's supply. At the front of the fuel tank, a pressure gauge showed the boost pressure.

Amazingly, you could use the bike for commuting. Apart from a longer cold starting procedure, necessitated by the nature of the Bendix carb, it was much like the stock Kawasaki, apart from sounding like a growling bear at the modest revs you'd use for getting around town.

That all changed the first time I took it out for a ride across country. Catching a queue of cars on a dual-carriageway at about 90mph and spinning the motor at 5000rpm I opened it up. Nothing much happened, so I snicked down two

SPECIFICATION

MODEL	Kawasaki Z1R (Z1000D1)	Kawasaki Z1R Turbo
ENGINE	Air-cooled in-line four	Air-cooled in-line four with Rajay turbocharger
CAPACITY	1,015cc (70 x 66mm)	1015cc (70 x 66mm)
VALVE OPERATION	Double-overhead camshafts, chain	–
COMPRESSION RATIO	8.7 to 1	8.0 to 1
LUBRICATION	Wet sump, capacity 3.7 litres	–
IGNITION	Twin coils and contact breakers	–
CARBURATION	Four 28mm Mikuni VM	40mm Bendix
PEAK POWER (CLAIMED)	90bhp at 8000rpm	115bhp at 9000rpm
PEAK TORQUE	62.9lb-ft at 7000rpm	na
PRIMARY DRIVE	Spur gears	–
PRIMARY RATIO	(97/56) 1.73 to 1	–
CLUTCH	Wet multiplate	–
GEARBOX	Five speed	–
INTERNAL RATIOS	3.17 (38/12), 2.19 (35/16), 1.67 (35/21) 1.38 (29/21) and 1.22 (28/23)	–
FINAL DRIVE	EK630S O-ring chain	–
FINAL DRIVE RATIO	(33/15) 2.2 to 1	(33/16) 2.06 to 1
OVERALL RATIOS	12.07, 8.34, 6.37 5.25 & 4.64 to 1	11.31, 7.82, 5.97, 4.92 and 4.35 to 1
FRAME	Tubular-steel duplex cradle	–
FRONT SUSPENSION	Telescopic fork	–
REAR SUSPENSION	Pivoted fork, twin shocks with five pos spring preload adjustment	–
FRONT WHEEL	18in cast alloy seven spoke	–
REAR WHEEL	18in cast alloy seven spoke	–
FRONT TYRE	Dunlop 350H18 F6 ribbed	Dunlop Red Arrow 410V18
REAR TYRE	Dunlop 400H18 K87	Dunlop Red Arrow 425/85VB18
FRONT BRAKE	Dual 295mm (11.6in) perforated discs Single-piston floating calipers	–
REAR BRAKE	295mm (11.6in) disc with dual-piston caliper	–
ELECTRICAL SYSTEM	Alternator with zener-diode voltage control, 60/55W H4 headlamp, starter motor	–
BATTERY	12v 14Ah	–
FUEL TANK	13 litres (2.86 gal) inc reserve	–
WHEELBASE	1505mm (59.5in)	–
SEAT HEIGHT	813m (32.0in)	–
CASTOR ANGLE	64 deg	–
TRAIL	85mm (3.3in)	–
WEIGHT (CLAIMED)	246kg (541lb)	–

gears and with 7000rpm on the clock the engine hesitated – the infamous turbo lag – then suddenly a giant hand grasped me and I lunged forward and, to use the now hackneyed metaphor, the world went into reverse. I felt like I was on an out-of-control roller-coaster as the traffic disappeared in my mirrors. Changing up twice to prevent the revs going off the clock I barely had time to glance at the speedo, but when I'd got used to what was happening I looked away from the road, and there was the needle rushing past the 150mph mark. The bike felt like it was about to tie itself in knots and even slowing down was an experience in itself.

Here was an example of what happens when you match a turbocharger best suited to two-litre or more car engines with a motorcycle. The Kawasaki wasn't making enough exhaust energy to usefully spin the Rajay until it reached about 6000rpm, and once it did the revs increased so quickly you'd pass the 8500rpm redline in a flash.

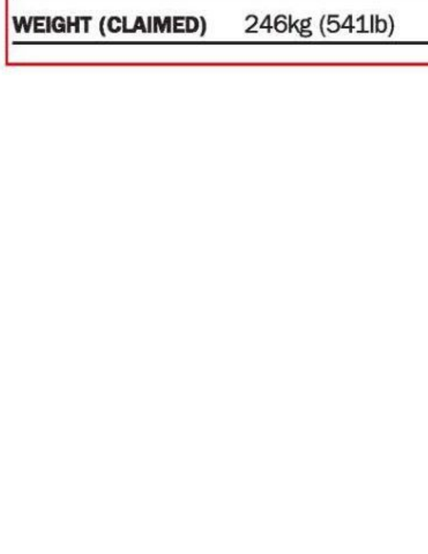
Although Russell Savory, still widely acknowledged as one of the UK's top engine tuners, was just starting out he was well clued in the mysteries of turbocharging. A key challenge when using the ATP kits at the time was controlling engine temperature. One way is to reduce the compression ratio, and wisely Savory had built the Z1R motor with 8 to 1 pistons and limited the boost pressure to 12 psi, as well as welding up the crankshaft.

Even so, when we took the bike to Santa Pod Raceway to find out just how quick it was the temperature limits were soon found, even though Savory changed the oil between runs.

With taller gearing giving 158mph at 9000rpm in top provided by a 16-tooth engine sprocket, the bike needed a careful application of the throttle and clutch while maintaining the revs above 6000rpm to get away from a standing start. Trouble is that until the engine is under load, it can't make any exhaust energy, but when it does, it takes off with a vengeance.

Estimates were that the Z1R Turbo was developing peak power in the region of 150bhp but with such a short fuse I doubt that it would have been possible to run the engine long enough on a dynamometer to find out.

I'm sure that many will scoff at the fact that the best standing quarter-mile time I could manage was 11.4 seconds with a terminal speed of 123.9mph. That's 8000rpm in fourth, suggesting that lower gearing would have been more appropriate.



But we never found out if it could be bettered. After the ninth run, and just when I was starting to get the hang of quick starts, a piston ring broke and the bike was parked in the truck.

So I wasn't able to check the top speed, not that I was that keen anyway.

They were crazy days. For a deposit of just £159 and payments of £28 a week you could be in charge of a 160mph hell-raising motorcycle that was barely controllable at its 'normal' top speed. No surprise it was a one-hit wonder.

Kawasaki subsequently produced its own GPz750 Turbo in the early 80s – a fine machine of its type but equally short lived. Now, modern bikes make enough power without the need for turbochargers, which find wider use in improving the fuel consumption in diesel cars and trucks.

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> "WHAT MADE THE BMW APPEALING TO TRADITIONAL TOURING RIDERS WAS A BROAD RANGE OF TORQUE AND A LESS FRENETIC DELIVERY THAT REDUCED RIDING STRESS."

Worth the WEIGHT

When BMW's classic R100T boxer twin met Suzuki's newly introduced GS1000G shaft-drive four in a touring tussle, only one outcome was expected. But as John Nutting discovered, the tide had turned.

Motorcycles for touring should be stress free with the emphasis on comfort, if not necessarily luxury. A touring motorcycle must be responsive and flexible, smooth, economical, reliable and undemanding.

Of all the world's manufacturers, BMW knew what was needed in a tourer long before the Japanese got in on the act. Their opposed, or 'boxer', twins had been developed from the early 1920s to be ultra smooth and dependable, while their drive shaft transmissions were almost maintenance free. By the 1960s, BMWs represented the pinnacle of high-class, if expensive, two-wheel travel. In contrast, most other bikes numbed their riders' fingers and posteriors and called for regular spannering.

Although the Japanese factories brought superbikes to the masses at the end of the 1960s, it was almost another 10 years before BMW's superiority with its touring machines was properly challenged.

Japan's ubiquitous multi-cylinder machines were smooth (ish) and reliable but it wasn't until shaft-drive versions appeared in 1977 that they could be considered as true touring competitors for BMW. Yamaha with its XS750 and XS850 triples, and its later XJ650 four, first tested the market, then in 1979 Kawasaki's Z1000ST and Suzuki's GS850 four appeared.

Of these, the Suzuki was the most competent offering, with precise handling that belied its hefty 560-pound (254kg) dry weight, a compact riding position and a flexible motor. So when in 1980 Suzuki launched the bigger GS1000G, I wondered if this could be the first Japanese shaft drive bike to really take BMW on in the touring tussle.

On paper it looked the part, using same basic components with a more potent engine specification taken from the brilliant GS1000E and hardly any additional weight. But could the lighter BMW still hold the trump cards over longer distances?

Trouble was that despite the excellent touring capabilities of their bikes, the BMW factory's quest for performance in the face of Japanese and Italian machines with 130mph plus top speeds was thwarted by the basic boxer twin design.

What made the BMW appealing to traditional touring riders was a broad range of torque and, as a consequence of using a large and heavy flywheel on the crankshaft, a

less frenetic delivery that reduced riding stress. The boxers also featured a slim chassis that, apart from the obvious feature of the cylinders jutting out either side, enabled the riding position to be roomy and comfortable.

A feature of shaft drive on a motorcycle is that there is a tendency under power for the rear suspension to lift, and under a closed throttle for the rear end to squat. In the 1970s it was a feature of a BMW that was accepted by owners as a characteristic of the design, as was the effect of the heavy flywheel when making quick manoeuvres, both of which could be particularly unnerving to the uninitiated when riding the higher performance models such as the R90S for the first time.

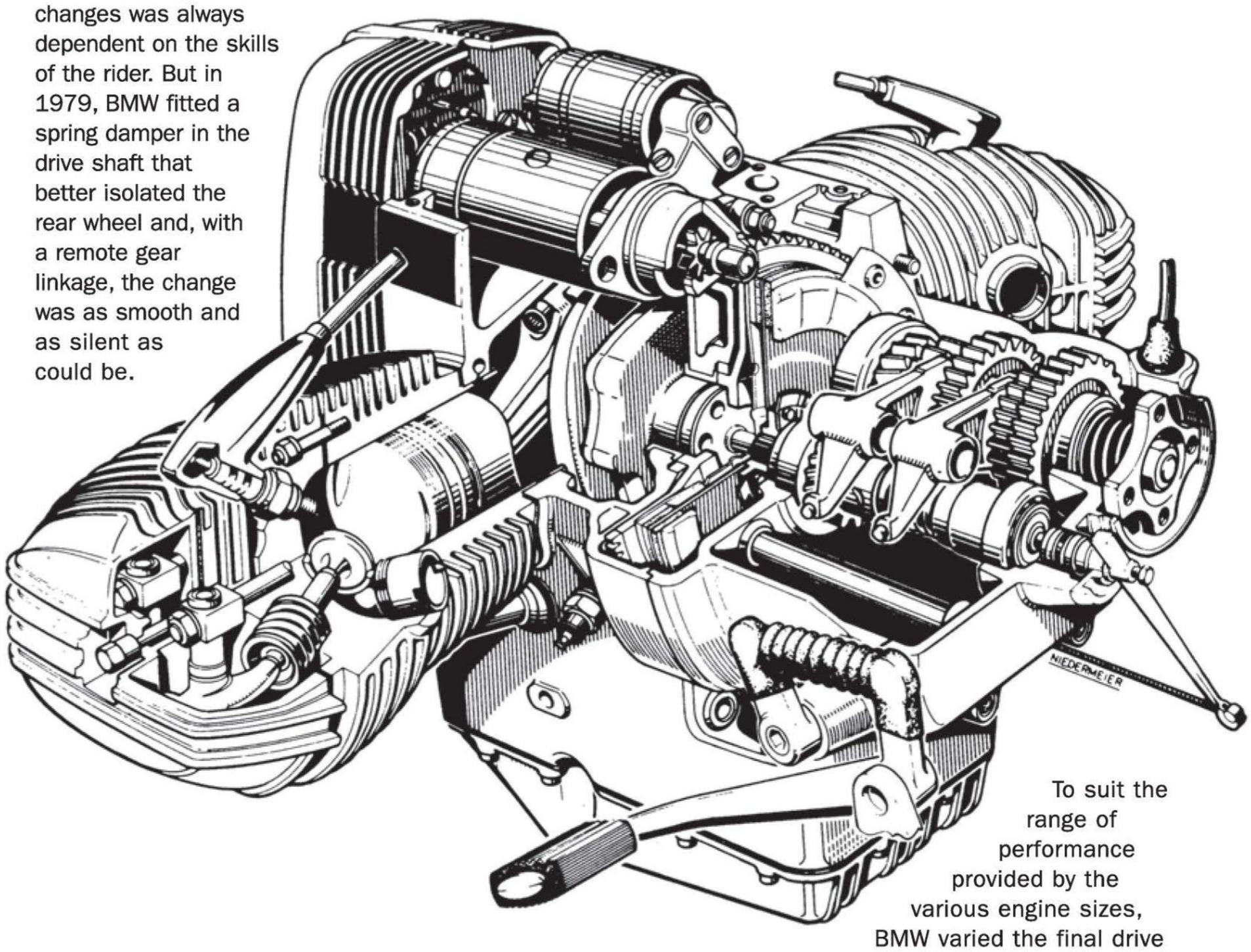
Until 1980, there seemed to be a quiet acceptance by BMW's designers that the marque's basic qualities – as was demonstrated in the 1979 R100RT with a full touring fairing – should be undiluted, and that the rest of the motorcycling world was out of step, but a policy change led to a dramatic change in design that would appear on the 1981 models, which were much more lively.

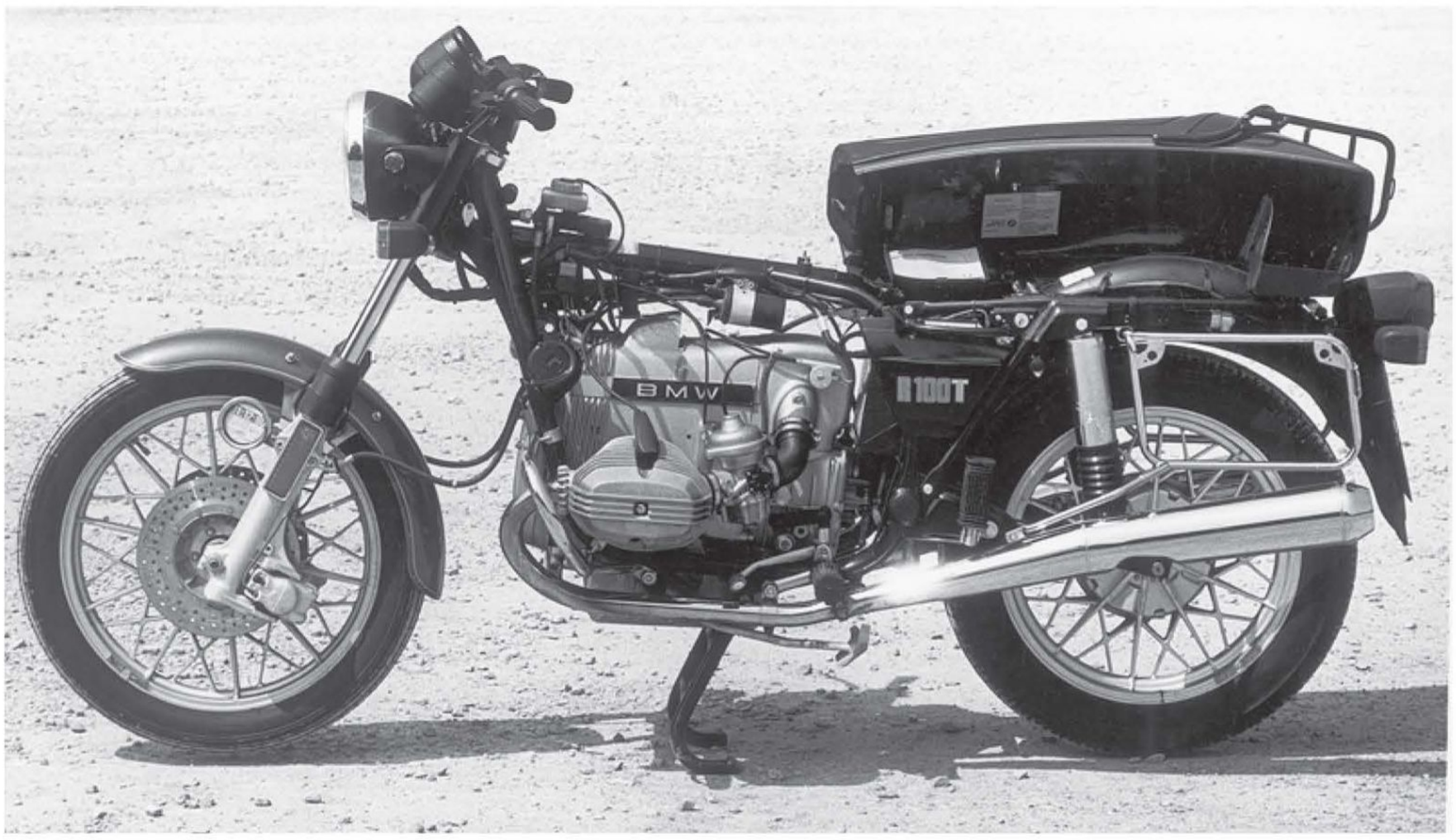
END OF THE OLD ORDER

In 1980, the old order lived on in a model that was in effect the last of the original line of BMWs, the R100T, a basic unfaired touring machine that was a development of the series that had started with the 745cc R75/5, the R75/6 and led to the 898cc R90/6, the 798cc R80/7 and the 980cc R100/7, all using the same basic five-speed engine and chassis but with detail changes. As capacity increased refinement suffered, particularly when the peak power reached 70bhp at 7000rpm in the R100RS.

With the R100T, BMW retuned the twin for a wider range of torque peaking at 55.7ft-lb at 5500rpm. Breathing through a pair of German-made Bing 40mm CV carburettors and with a compression ratio of 9.5 to 1, the R100T's power peaked at a claimed 65bhp at 6600rpm.

Power transmission was through a five-speed gearbox running at about three-quarters engine speed connected to the rear wheel by a Hook-type universal joint, cardan shaft and spiral bevel gears. Because the gearbox ran at a higher speed relative to the rear wheel than on conventional bikes, the crispness of changes was always dependent on the skills of the rider. But in 1979, BMW fitted a spring damper in the drive shaft that better isolated the rear wheel and, with a remote gear linkage, the change was as smooth and as silent as could be.





To suit the range of performance provided by the various engine sizes, BMW varied the final drive ratios in the rear wheel's bevel gears. For the R100T, the highest ratio was selected, 2.91 to 1, which at 70mph equated to relaxed engine revs of slightly less than 4000rpm. Despite the higher gearing there was still plenty of punch through the gear ratios.

In almost every other respect, the R100T's chassis was much like the R90S of five years earlier, featuring a duplex loop frame using oval high-tensile steel tubing. Up front, the long-travel telescopic fork with axle mounts on the front of the sliders supported floating calipers for the brakes, which in turn were mounted on snowflake-pattern light-alloy wheels. Rear brake was a simple drum.

What set the R100T apart from earlier boxer twins was its rear suspension. Until 1980, simple coil-spring shocks with manual spring adjusters were

thought adequate, but the novel feature of this model was the use of shocks that automatically adjusted the ride height regardless of load.

Self-levelling of the air-sprung Nivomat shocks designed by Boge was accomplished by an internal oil pump connected to the damping circuit. The pump continuously circulated oil from an inner low-pressure chamber when the shock was moving to a high-pressure chamber that was separated from the annular air-spring chamber by a rubber diaphragm. Under high loads, and an initial low ride height, the pressure in the high-pressure chamber increased until the set ride height was reached. Then a control sleeve opened and oil spilled back into the low-pressure chamber.

Conversely, under a lighter load the oil spilled again until the set height was reached, usually taking a few hundred yards. For anyone regularly carrying passengers it was a boon, if only because the handling remained more consistent (the damping also increased with a heavier load) and the headlamp beam didn't need adjusting at night.

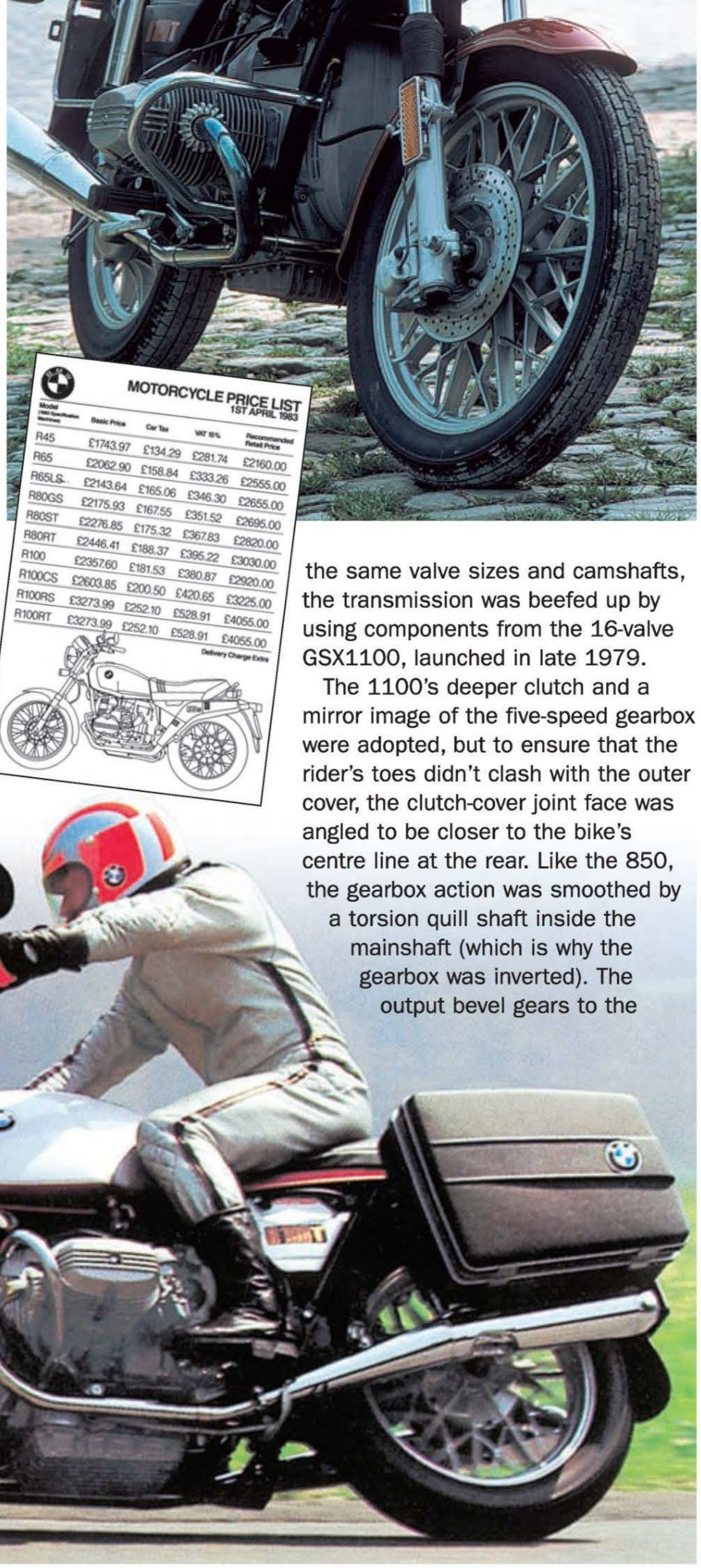
LIGHTWEIGHT AND HEAVYWEIGHT

By modern standards, the R100T's dry weight of 473 pounds might seem heavy for such a simple machine, but it was a lightweight alongside the Suzuki GS1000G, which weighed in at a hefty 562 pounds, about the same as the GS850G and Z1000ST.

Suzuki's engineers could easily have created the GS1000G by simply upgrading the GS850G with the longer-stroke roller-bearing crankshaft and bigger-bore double-overhead camshaft top end of the chain-driven GS1000E, but it was found that the 850's clutch was weak under heavy loads.

So in addition to the capacity increase to 997cc from the 70 x 64.8mm bore and stroke, along with the same valve sizes and camshafts, the transmission was beefed up by using components from the 16-valve GSX1100, launched in late 1979.

The 1100's deeper clutch and a mirror image of the five-speed gearbox were adopted, but to ensure that the rider's toes didn't clash with the outer cover, the clutch-cover joint face was angled to be closer to the bike's centre line at the rear. Like the 850, the gearbox action was smoothed by a torsion quill shaft inside the mainshaft (which is why the gearbox was inverted). The output bevel gears to the



TEN YEARS OF FLAT TWINS TO 1980

1969 New BMW range launched with all-alloy engines and telescopic forks: 498cc R50/5, 598cc R60/5 and 745cc R75/5.

1973 BMW's 50th anniversary celebrated with launch of 898cc R90S

with bikini fairing, dual disc brakes and bigger Dellorto carbs. Launch of 598cc R60/6, 745cc R75/6 and 898cc R90/6 with revised controls.

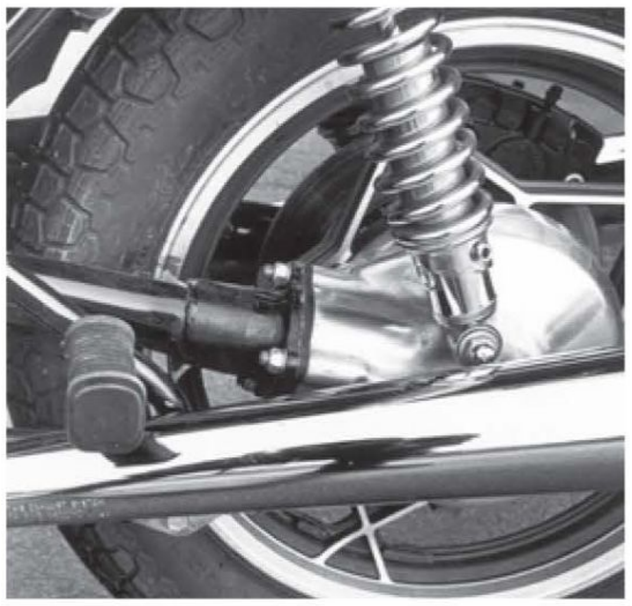
1974 R75/6 in production with single disc brake.

1975 Kick-starter removed.

1976 Launch of the fully faired 980cc R100RS sports tourer along with the R60/7, R75/7 and R100/7 and R100S.

1978 Launch of R100RT with touring fairing and pannier equipment. Launch of 450cc R45.

1979 R100T launched with Nivomat suspension. R80GS launched,



cardan shaft were lubricated in a separate casing but in unit with the engine, enabling the bike to be no wider across the footrests than the chain-drive version.

Like the BMW, the GS1000G was fitted with CV carbs, in this case a quartet of 34mm Mikunis that both lightened the twistgrip action and improved power over the GS1000E, giving a claimed 91bhp at 8500rpm.

MODEL HISTORY, SUZUKI SHAFT-DRIVE HEAVYWEIGHTS

1979 Suzuki GS850G introduced. Eight-valve dohc four, 844cc 78bhp, 557lb.
1980 Suzuki GS850GL custom introduced (USA).
Suzuki GS1000G introduced. Eight-valve dohc four, 997cc, 91bhp, 562lb.

Suzuki GS1000GL custom introduced (USA).

1981 GS1000G continued. Revised seat, indicators.
GS1000GL continued.
1982 GS1000G discontinued May GS1100G introduced June. Eight-valve dohc four, 1074cc, 98bhp, 543lb.

GS1100GK with touring fairing and equipment introduced. 98bhp, 639lb.

1984 GS1100G, GS1100GK discontinued.
1988 GS850G discontinued.

- **Source: www.suzukicycles.org**

The GS1000G was also bigger all round than the BMW, with a wheelbase of almost 60 inches, but was also provided with a fashionably high level of adjustability for the suspension. The front fork featured four-position spring preload adjustment while the rear shocks offered four damping positions in addition to the usual spring preload.

REAL ROAD PERFORMANCE

As you'd expect, the Suzuki could blow off the BMW in a straight line with ease. Though much heavier, the GS1000G's top-end power would leave the R100T panting at almost 120mph with another 10mph in hand.

Acceleration of the four was much stronger too, with a quarter mile time of 12.4 seconds about a second quicker than the twin.

But on the open road and even on motorways there wasn't much between the two bikes. Interestingly, the Suzuki's four-cylinder engine and impeccable transmission made it the more flexible of the two, enabling it to pull away from a standstill in top gear, or trickle along in bottom gear at a walking pace.

It wasn't all top end power either, with ample response up to 5000rpm, enhanced by the light twistgrip action, giving a range up to 90mph or more without need to play on the gear lever. Rev it and the exhaust remained muted, although the vibration started to intrude and faze the images in the rear view mirrors, despite them being rubber mounted.

What appealed about the Bee-Emm was the lack of drama when maintaining high average speeds on country roads. Like the Suzuki it would pull away with the Bings just off their stops and it made little difference if you explored the red line just above 7000rpm. Keep up a smooth rhythm and using high gears the torque from the twin would be enough to haul out of corners at speeds that belied the muted mechanical tinkling from the cylinder heads below your knees. Indeed, the most noise came from the inlet system drowning the tappets.

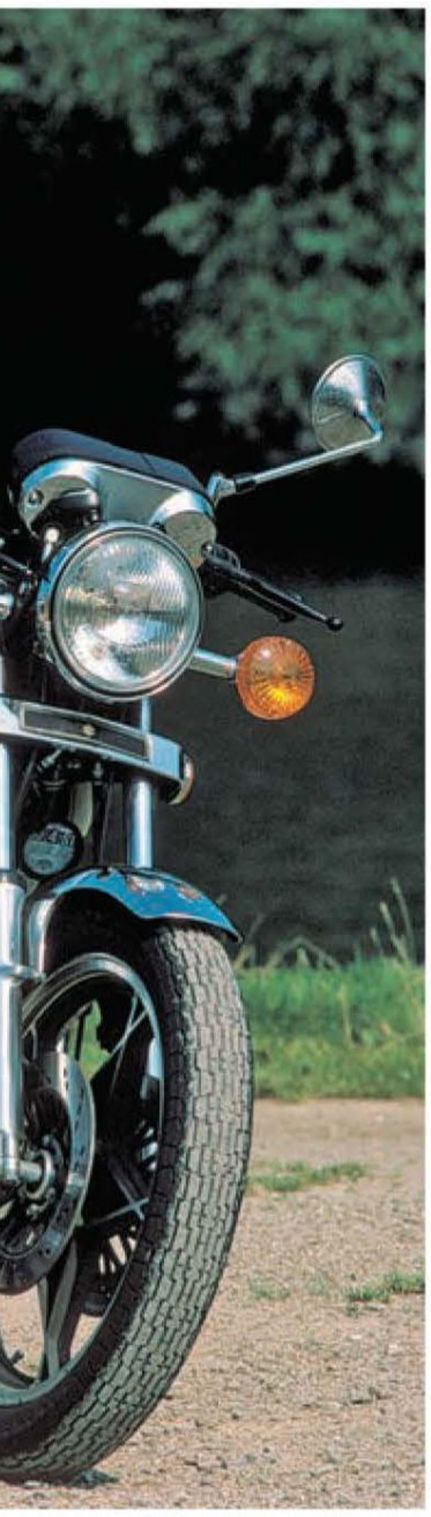
The once unparalleled refinement of a BMW was starting to wear thin however. At higher cruising speeds, and especially on motorways when you had nothing much else to consider, vibration was transmitted through the handlebar, while at low revs the torque pulses through the transmission – a legacy of the bigger pistons without a bigger flywheel – were often intrusive.

This Bee-Emm's clutch was also inclined to be grabby, though it suffered no less than the Suzuki's, which would drag when hot.

QUIRKY BEHAVIOUR

Hold a constant throttle through fast bends and the Bee-Emm felt taut and secure, largely a result of a short 57.7-inch wheelbase and a low centre of gravity. But clumsiness with the twistgrip would be punished with a twitch from the engine's flywheel, not to mention pitching from the rear suspension. In the old days a Bee-Emm didn't do that because there wasn't much suspension travel or, come to that, much power.

Skill and smoothness would be rewarded with one of the most delightful experiences in motorcycling as rider and machine conspired in harmony to cleave through corners with the minimum of drama. All this came with a supremely neat riding position.



Although the Bee-Emm seemed bulky – you can't ignore those pots measuring 30 inches across – in fact it was very compact with a slim eight-inch wide seat and footrests with tips just 21.5 inches across and 11.5 inches from the deck. The only bother (for the non-Bee-Emm rider, at least) was that one footrest was slightly ahead of the other because of the offset of the cylinders. And to fit the first aid kit under the seat, the padding had been trimmed.

Suprisingly, what on earlier models of BMW had felt like an armchair after hundreds of miles was not much better than a slab of concrete after just a few minutes.

In contrast, the Suzuki GS1000G seemed much larger, though overall there wasn't much in it between the two. The wheelbase, at 59.1 inches, was just over 1.3 inches more and the seat height 32 inches, in fact slightly lower than the Bee-Emm's.

What made the difference was that the seat was wider by an inch and a half and the footrests 25 inches across and higher by an inch and a half, all of which added up to more bulk.

Surprisingly, the Suzuki carried itself well despite this initial impression, and it handled much better than expected with supple suspension and neutral steering. The only beefs were my inability to find a suspension combination that would minimise wallowing when the rear dampers were hot.

And more to the point, you didn't have to acquire any mystical skills to ride the Suzuki with alacrity. Though also having shaft drive, the Suzuki didn't suffer from pitching, even though there was more power to play with. And a moment's study of the bike's rear end showed partly why: the swing arm, longer at 18inches by two inches compared with the Bee-Emm, reduced the leverage of the shaft.

Braking too had been improved on the Suzuki range, with better pad materials for the three slotted discs, along with a more comfortable hand lever.

In contrast, the Bee-Emm retained a drum rear brake to complement the dual discs up front. The problem, again, was the Bee-Emm's long travel suspension that pitched the bike forward under hard braking.

The key to unhurried touring is not having to keep stopping for fuel. As a rule, the later German boxer twins came with big 5.3-gallon tanks that, even when caned, would offer a reasonable range. The R100T managed between 43 and 45mpg giving a range of up to 230 miles, enough for most riders' needs.

SPECIFICATIONS

MODEL	SUZUKI GS1000G	BMW R100T
ENGINE	Air-cooled inline four	Air-cooled opposed twin
CAPACITY	997cc (70 x 64mm)	980cc (94 x 70.6mm)
VALVE OPERATION	Double overhead camshafts	Pushrod overhead valves
COMPRESSION RATIO	9.2 to 1	9.5 to 1
LUBRICATION	Wet sump	Wet sump
IGNITION	Electronic inductive	Coils and contact breakers
CARBURATION	Four 34mm Mikuni CV	Twin 40mm Bing CV
PEAK POWER	91bhp at 8500rpm	65bhp at 6600rpm
PEAK TORQUE	59.5ft-lb at 7000rpm	55.7ft-lb at 5500rpm
PRIMARY DRIVE	Gears	Helical gears
PRIMARY RATIO	1.775 to 1 (87/49)	na
CLUTCH	Wet multiplate	Dry, single plate
GEARBOX	Five speed	Five speed
INTERNAL RATIOS	2.5, 1.778, 1.380, 1.125 & 0.961 to 1	4.40, 2.86, 2.07, 1.67 & 1.50 to 1
FINAL DRIVE	Shaft and bevel gears	Shaft and bevel gears
FINAL DRIVE RATIO	3.09 to 1 (34/11)	2.91 to 1
OVERALL RATIOS	12.9, 9.17, 7.12, 5.81 & 4.96 to 1	12.8, 8.32, 6.02, 4.86 & 4.37 to 1
FRAME	Duplex tubular-steel cradle	Duplex tubular steel cradle
FRONT SUSPENSION	Telescopic fork, 4-pos spring preload	Telescopic leading-axle fork
REAR SUSPENSION	Pivoted rear fork, twin shocks	Pivoted rear fork, twin self-levelling with 5-pos spring preload, shocks, with adjustable air spring and 4-pos damping adjustment
WHEEL, FRONT	Cast aluminium alloy 19in	Cast aluminium alloy 19in
WHEEL, REAR	Cast aluminium alloy 17in	Cast aluminium alloy 18in
TYRE, FRONT	IRC Grand High Speed, 350V19	Metzeler 325H19
TYRE, REAR	IRC Grand High Speed, 450V17	Metzeler 400H18
BRAKE, FRONT	Dual 275mm discs, floating caliper	Dual 10.4in discs, floating calipers
BRAKE, REAR	Single 275mm discs, floating caliper	200mm (7.9in) drum
ELECTRICAL SYSTEM	250W alternator, 60/55W H4 headlamp,	280W alternator, 60/55w Bosch starter motor H4 headlamp, starter motor
BATTERY	12v 14Ah	12v 28Ah
FUEL TANK	21.8 litres (4.8 gallons)	24 litres (5.3 gallons)
WHEELBASE	1500mm (59.1in)	1465mm (57.7in)
SEAT HEIGHT	825mm (32.5in)	838mm (33in)
CASTOR ANGLE	62 deg	62 deg
TRAIL	4.4in	3.5in
WEIGHT (DRY, CLAIMED)	562lb	473lb
PERFORMANCE		
MAXIMUM SPEED	130mph	120mph
SPEEDS IN GEARS	50mph	39mph
	70mph	61mph
	90mph	84mph
	129mph	115mph
ACCELERATION, 1/2 MILE	12.4 sec	13.5 sec
FUEL CONSUMPTION	43mpg	44mpg
RANGE	205 miles	233 miles

The Suzuki's consumption varied more, from 37mpg to 51mpg, possibly because of the dual nature of the machine – either hot rod or cruiser whenever you felt like it – but that meant you could eke out up to 245 miles from the 4.8-gallon tank.

SURPRISE WINNER

My preconceptions expected the BMW R100T to offer the typical characteristics of the marque: comfort, flexibility, touring range and fine handling. The Suzuki was expected to be big and bulky, though fast and furious.

In fact, the Bee-Emm was the more sporty; yet lacked long-distance credentials because of its poor seat. Despite the Suzuki's weight it was flexible and unhurried, though it could hustle if called upon, rather like a Shire horse beating a steeplechaser.

But BMW's 1980 models would later be upgraded with better, lighter and more responsive engines with improved lubrication allied to chassis with Brembo brakes. Full though they were, it was only a matter of time before the factory would launch its four-cylinder range in 1983, and later a whole new boxer twin range that lives on now with even greater touring popularity.

Revised, bigger capacity but more obscure, four-cylinder Suzukis such as the GS1100G and GSX1100F would appear in following years but the factory's emphasis would move to pure sports bikes. And the GS1000G would live on as a pinnacle of classic naked Japanese touring capability from the 80s.

YAMAHA XS1100

Heavy Metal

Yamaha's XS1100 was the Iwata factory's first attempt at a big sports-touring machine. John Nutting tested versions on both sides of the Atlantic.

Originally printed in the January 2004 issue of *Classic Motorcycle Mechanics*

classic motorcycle mechanics

1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986

Testers were amazed at the engine's roll-on power.

YAMAHA XS1100

ENGINE

Air-cooled in-line four
Capacity, 1101cc (71.5x68.6mm)
Valve operation, double overhead camshafts
Compression ratio, 9.2 to 1
Lubrication, wet sump, 4-litre capacity, cooler
Ignition, electronic inductive
Carburation, four 34mm-choke Mikuni CV
Peak power, 95 bhp at 8,000 rpm
Peak torque, 66.5 lb-ft at 6,500 rpm

TRANSMISSION

Primary drive, Hy-vo chain and gears
Primary ratio, 1.657:1
Clutch, wet multiplate
Gearbox, five speed
Final drive, shaft and bevel gears
Overall ratios, 2.235, 1.625, 1.285, 1.032, & 0.882:1

CHASSIS

Frame, Duplex tubular steel cradle
Front suspension, telescopic fork, 3-pos preload adjustment
Rear suspension, pivoted fork, two spring-damper units with 5-pos preload adjustment

WHEELS

Front wheel, cast aluminium alloy
Rear wheel, cast aluminium alloy

TYRES

Front tyre, Bridgestone Mag-Mopus 350V19
Rear tyre, Bridgestone Mag-Mopus 450V17

BRAKES

Front brake, 298mm dual discs, floating single-piston calipers
Rear brake, 298mm single disc

ELECTRICS

Alternator, 60/55W headlamp, starter motor

WEIGHTS AND MEASURES

Battery, 12V-20Ah
Fuel tank, 20 litres (4.4 gal)
Wheelbase, 1,568mm (61.75in)
Seat height, 813mm (32.0in)
Castor angle, 60.5 deg
Trail, 130mm (5.12in)
Weight, 255kg (562lb) claimed.

WE'D expected Yamaha to bring out a heavyweight tourer, but the first time its existence was confirmed was in September 1977. I'd been touring across the US on an XS750E triple and called the West Coast Yamaha headquarters from a phone box by I-70 in Green River, Utah, to tell them I'd been delayed by a puncture.

"What about this XS1000," (which it was at the time), I asked, and they said yes, it would be launched soon.

The XS750 had performed well from new, hauling me more than 2000 miles from New York and over the Rockies in five days including detours in Michigan and Colorado. The big four could only be better.

This was the time when the big four Japanese manufacturers were on the verge of a slugging match to show which could offer the best full-litre performance bike. Kawasaki had its well-established Z1000 and Honda its Gold Wing flat-four. Pictures of Honda's amazing CBX six had been shown and a 1000cc version of Suzuki's GS750 four was imminent.

The first picture of Yamaha's beast revealed it as an across-the-frame dohc four with shaft drive, essentially a bigger version of the bike I was riding with an extra cylinder. But it turned out to be much more.

Early production models were released late in 1977 to the US magazines who found that it was in fact an 1101cc four and designated the XS1100. Unlike the 750cc triple, which had its double overhead camshafts driven in what turned out to be a now-contemporary arrangement with a chain on the right end of the crankshaft, the XS1100 was symmetrical with the camshaft drive chain in the centre of the crank between the two inner cylinders, adjacent to the inverted-tooth primary chain.

Where the triple's chain had been troublesome, the four's drive was through a countershaft to a huge clutch and five speed gearbox, then by another countershaft to spiral bevel gears and a universal joint to the rear wheel's drive shaft.

The engine looked huge, its swept volume of 1101cc arriving from a one-piece crankshaft with the same 68.6mm stroke as the triple but with the bores increased from 68mm to 71.5mm with pistons that would also be used in the following year's XS850 triple.

Its architecture established a trend for litre-plus engines that would be followed by the other manufacturers: crankshaft lubrication was by a high pressure system with plain bearings established by Honda and Kawasaki on their sub-750cc fours.

This enabled more cost-effective manufacturing systems than used with built-up roller-bearing cranks. Ignition was novel in that it used electronically-triggered inductive coils rather than the then-troublesome capacitor discharge designs. Timing advance was also controlled both by engine speed and an automotive system inside the end cover that used the intake pressure - effectively the throttle opening of the four 34mm Mikuni CV carbs.

Curiously, although other designs would exploit the use of a countershaft behind the crank to drive an alternator and enable the width of the engine to be reduced, Yamaha adopted a conventional set-up. Despite this, the width was still only 23 inches, just 1.5 inches wider than Kawasaki's Z650.

To support this unit, the steel duplex cradle frame was no less substantial and an inevitable result of using a long engine and shaft drive was a 60.5in wheelbase. Weight, even dry, was 562 pounds, some 50 pounds more than the 750 Yamaha and 55 pounds more than Kawasaki's Z1.

Remarkably, first impressions of the XS1100's performance and handling were overwhelmingly positive. At Cycle magazine, one of the first to test the bike in the US, it was the "quickest bike they'd ever tested" but then they'd not yet ridden Honda's CBX or Suzuki's GS1000, or for that matter, Laverda's very special 981cc Jota which hadn't reached North America in its unrestricted form.

On a drag strip, the Cycle tester clocked a

European model differed in many ways to the US cruiser.

quarter-mile elapsed time of 11.83 seconds with a terminal speed of more than 115 mph. For such a heavy bike with shaft drive, this was phenomenal.

There was more up the XS1100's sleeve though. Especially noteworthy was its awesome roll-on acceleration. Both the US testers and the Europeans who attended the bike's launch in Senegal in West Africa in the Spring of 1978, were amazed at the way in which the bike could pull hard in top gear from 4000 rpm, often humiliating other 1000cc bikes even when they had to been dropped into fourth gear.

Yamaha may have been modest in its power claims. With a peak of 95 bhp at 8000 rpm, the 1100 provided about the same specific power as the 750 (which had 67 bhp) but the spread of torque was immense, with a curve that reached 42 lb-ft at 2000 rpm and peaked at 66.5 lb-ft at 6500 rpm.

Throttle response was all the more sublime because the rubber-mounted engine was so smooth: some said it was the smoothest heavyweight ever, even eclipsing Honda's silky Gold Wing.

Tester Nutting called it the Cadillac of the motor cycle world. "Heavy and luxurious."

SENEGAL LAUNCH

FOR a reason that I can't recall, I missed the Senegal launch (at which the SR500 single was also first revealed) and the arrival of the test bike from Mitsui Machinery Sales, Yamaha's UK importer, at Motor Cycle Weekly, for whom I was then writing, wasn't until the October of 1978.

But because I was again in America with the intention of riding east-west through the southern states and Yamaha was providing the machine, the first XS1100 I rode was a 1979 model. In the US, it was usual for the next year's models to appear early, so because I was there in September it was natural for the agent to provide a brand-new machine.

My intention was to ride from Atlanta, Georgia, across to Texas and New Mexico, Arizona into California. But however ideally suited was the XS1100 to such a trip, I hadn't reckoned on the weather.

Setting off in sultry humidity, I soon rode into a storm that was so unrelenting that I abandoned the plan and at Birmingham, Alabama, turned north towards the home of country music city, Nashville, Tennessee, before returning to Atlanta to catch a red-eye plane west. Okay, so I wimped out but what would 1000 miles of grisly wet purgatory have proved?

As it turns out the 700-mile two-day round trip proved if nothing else that the XS1100 was the best available big tourer: both smooth and potent with a useful 180 miles before dipping into the reserve, even when cruising at 80-90 mph.

Sure, the freeways with their 55 mph speed limits placed few demands on the bike but it never needed juggling with the gear lever because a snap of the wrist in top gear was all that was needed to launch you past 18-wheel trucks. Just as well, because the gear change mechanism was still one of the clunkiest I'd ever experienced, despite Yamaha's attempts to improve it since the bike's launch a year earlier.

My experience with the US-version XS1100 illustrated just how different were the specifications from Europe's models.

Cosmetically, the engine was silver painted rather than black; the fuel tank was smaller and the handlebar higher and wider. Closer scrutiny revealed that the footrests were placed two inches further forward for a more relaxed riding position. Inside, the engine had leaner fuel metering to satisfy the US emission laws.

Riders of 21st century machines will wonder just how it's possible for a machine weighing more than 250 kilograms to be anything but a handful. Indeed, in a European context that's partly true, but the XS1100 on US freeways was a paragon of stability. Despite having suspension designed for comfort, the bike coped with high-speed sweeping bends well, partly a result of the long wheelbase, and offered more cornering clearance than you'd expect.

This was why the XS1100 was more enthusiastically received in Europe than the Gold Wing, the true nature of which as a touring machine had yet to be fully appreciated at the end of the Seventies.

A month later back in the UK I took delivery of Yamaha's test machine, which unusually had clocked more than 8000 miles. Whether it was the worse for wear or just the more demanding roads in Europe but I was less impressed by the bike's roadholding.

I called it the Cadillac of the motorcycle world, "Massive, heavy and luxurious ... but with cornering behaviour that demands caution." It was one of the most attractive superbikes on the market, I said. "It's very fast, very smooth and very comfortable. And its shaft-driven transmission... cuts maintenance chores to the minimum.

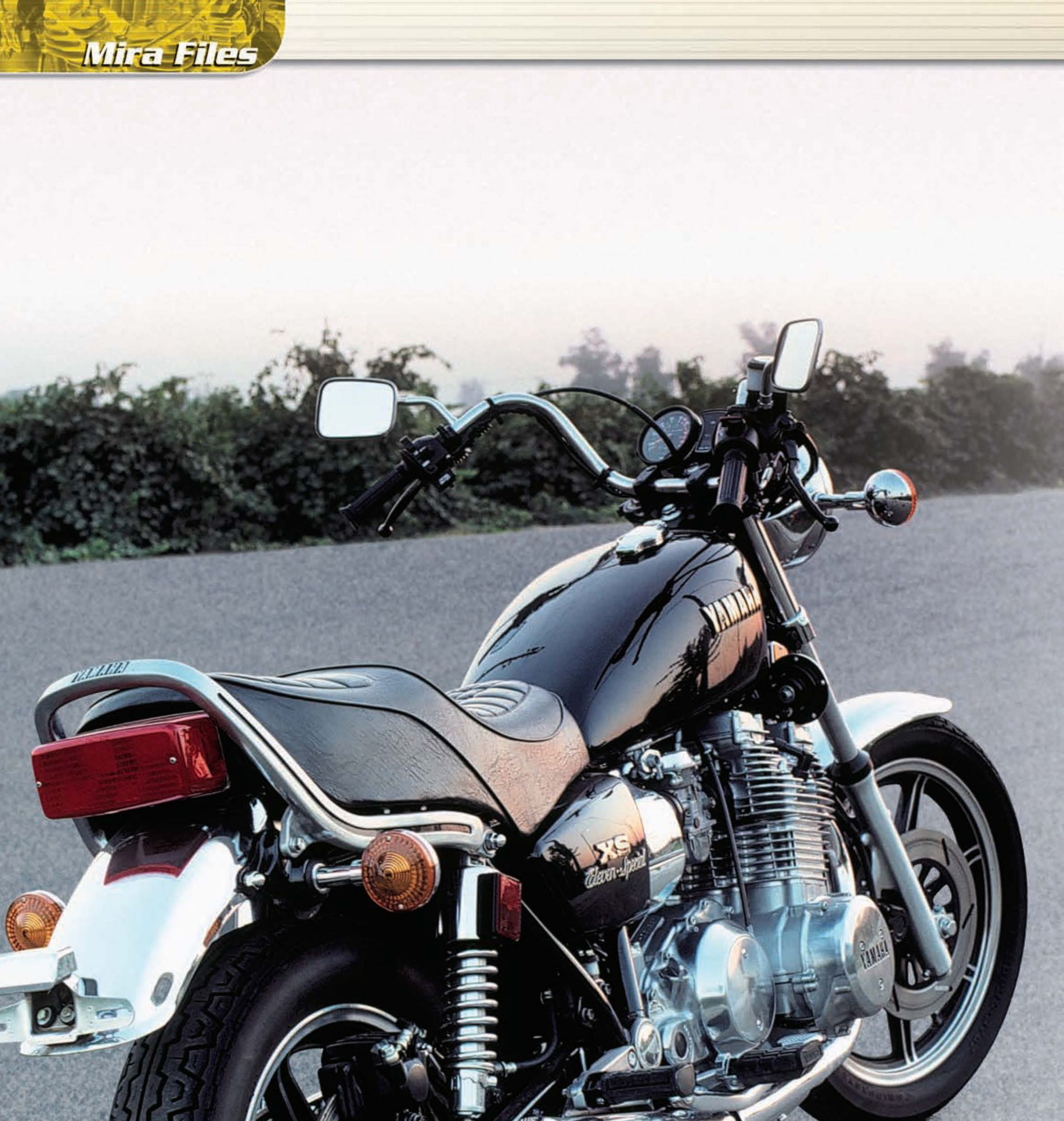
"There are so many neat features on the bike - silky controls that are well protected from the elements, a powerful and easily adjustable headlamp, simple removal of the rear wheel, self-cancelling indicators and a high quality of finish - that it is remarkable that Yamaha can offer it for as low a price as £2126 including VAT."

That made the Yamaha almost £1000 cheaper than BMW's R100RS flat twin and some £150 more than either Kawasaki's Z1R or Suzuki's GS1000, both of which it could outperform even with its heavy shaft drive.

The XS1100 combined touring comfort with stunning performance. "Japan's nearest equivalent is the similarly shaft driven Gold Wing," I said. "But even in its touring role the

STARTING SERIAL NUMBERS BY YEAR/MODEL AND COUNTRY

YEAR	MODEL	US	CANADA	EUROPE
1978	E	2H7-000101	2H8-000101	2H9-000101
1979	F	2H7-020101	2H8-110101	2H9-020101
1979	SF	3H3-000101		
1980	G	3H5-000101		
1980	SG	3J6-000101	3U9-000101	
1980	LG	4H3-000101	4H4-000101	
1981	H	4R1-000101	4T1-000101	
1981	SH	4R0-000101		
1981	LH	4W1-000101		
1982	XJ	10M-000101		



Customised model with stepped seat, high bars and shortened exhaust system.

Moody, all black, XS 1.1 model introduced later.

Yamaha wins hands down for luxury and pulling power - and then adds the bonus of better cornering clearance."

British roads exposed the flaws in the XS1100's handling quite easily. While the bike was fine on smooth, fast bends it didn't take much in the way of surface irregularities to upset its composure.

I was bothered by the UK model's heavy low-speed steering and a flutter that would demand real concentration to keep under control. The problem was partly related to the geometry - a head angle of 60.5 degrees (29.5 deg in modern parlance) combined with more 5.1 inches (130mm) of trail - which although fine at speed was almost overwhelming at town speeds and not helped by a front fork (it looked similar in dimensions to the XS750's) that was at best flimsy enough to flex in normal use. Only adjustability offered in the suspension was to spring preload.

The inability of the suspension to cope with the heavy wheels didn't help the braking performance. The use of twin 298mm discs at the front would, in normal circumstances, provide ample power and from high speed they did. But the combination of nearly 600 pounds of machine made them very sensitive at lower speeds and they've proved too easy to lock up during emergency stops.

After the top speed runs, the front discs were distorted enough to touch the caliper mounts. The stopping distance from 30 mph of 30.5ft (9.3m) was poor in comparison to the bike's contemporaries.

But this didn't diminish my liking for the XS1100. It was so refined yet blisteringly quick off the mark you could forgive it a few foibles. And if you rarely found yourself in town (as I did in the US) the problems rarely showed up.

HEART STOPPING

THE MIRA performance testing session on a windy day in October 1978 must have been heart stopping, though I made no note of the fact at the time. During the flat-out top speed runs I clocked 135.99 mph with a 15 mph tail wind, the engine revving to nearly 9000 rpm.

In the opposite direction the best speed was 127.94 mph giving a two-way mean of 131.97 mph, just 0.2mph more than Suzuki's GS1000. Acceleration through the quarter mile was very slightly better than the Suzuki, the XS1100 recording a two-way mean of 12.29 seconds over MIRA's 440 yards (rather than on a grippy drag strip) and reaching 60 mph in about 3.8 seconds.

Suzuki's GS1000 managed a slightly higher terminal speed - 110.3 mph compared to the Yamaha's 109.97 mph - but the XS1100 felt it was like a moving mountain. Only one bike was quicker through the quarter mile and that was Honda's CBX (11.75s at 116.3 mph).

Yamaha used the XS1100 platform for a number of derivatives. In the US it produced the moody all-black XS11 custom machine, the leader of a range of similar models. In Europe, a novel touring fairing was designed by John Mockett (who still does cartoons for MCN) and a sports model derived from the custom models with a handlebar fairing called the 1.1, elicited favourable reviews.

This enjoyed the use of bigger valves (38mm inlets rather than 36mm) and 32mm exhausts rather than 31mm and an exhaust camshaft with a 0.5mm higher lift (taking up to the inlet's 8.8mm).

This had originally been introduced onto the US models in 1980 to compensate for the power loss created by the demands of leaner carb settings.

Ideally, Yamaha should have included some stowage room and completely revised the suspension so that it could cope with the bike's weight. The huge flexibility of the engine combined with its smoothness was what made it so appealing.

Instead they replaced it with the leaner and lower FJ1100 which also offered a fairing, though a chain was used for the final drive. So much for long-distance durability.

PERFORMANCE DATA

All figures compiled at Motor Industry Research Association's proving ground, Nuneaton, Warwickshire.

MODEL

Yamaha XS1100

DATE OF TEST

25 October 1978

REG NO

CGK 27S

CONDITIONS

Cloudy, 55degF, 15mph wind

MEAN TOP SPEED (MPH)

131.97

BEST ONE-WAY (MPH)

135.99

MEAN NORMALLY SEATED (MPH)

116.04

STANDING QUARTER-MILE (MEAN, SECS/MPH)

12.29/109.97

ACCELERATION (SECS/MPH)

110 yards	4.9/70.1
220 yards	8.0/88.9
330 yards	10.2/98.9

CONSTANT SPEED MPG @ MPH

30	65.6
50	68.8
70	46.4

OVERALL FUEL CONSUMPTION

38mpg

BRAKING DISTANCE (FROM 30 MPH)

30.5ft (9.3m)

TURNING CIRCLE

16.5ft (5.0m)

SPEEDO ACCURACY, ACTUAL MPH AT INDICATED

30	31.2
50	50.4
70	68.0
90	88.6

TEST WEIGHT (1 GAL FUEL)

596 lb

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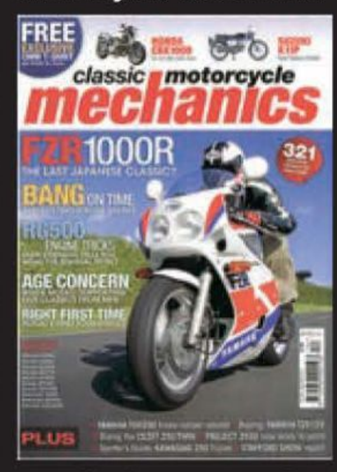


classic motorcycle mechanics

Celebrity CLASSIC

Suzuki's GS750 marked a new era in Japanese motorcycle design, performance and handling. **John Nutting** tested two, and four of their derivatives in the 70s and 80s.

In 1976 Suzuki may have been the last of the Japanese factories to bring out a proper four-stroke superbike, but the wait was certainly worth it.

The GS750 proved that Japanese big bikes could be made to handle with precision – until then we'd grown accustomed to the unruly speed of Kawasaki's Z1, thinking that this was just the price you paid for barely harnessed power. With Honda's CB750, which had properly established the superbike era seven years earlier, handling was secondary to luxury and refinement. Neither could match the handling of British or Italian superbikes of the time.

1976 was a turning point year for motorcycling in many ways. We had one of the hottest summers in memory, and while Barry Sheene won the first of his two world titles, the British bike industry was in collapse. Some great new bikes were being introduced. Yamaha launched its unusual XS750 shaft-drive early in the year and then Kawasaki its agile Z650 four.

But it was Suzuki that overturned our preconceptions about Japanese motorcycles with the GS750. Here was a machine that went where you pointed it and didn't have any nasty behavioural traits; it actually invited you to ride through the twisty stuff with gusto. Not only that, the GS750 was fast and, as it turned out, robust.

Yet this came in what we recognised at the time as a conventional package. Place the GS750's profile against that of most big bikes and you wouldn't be able to detect much difference. Wheelbase, rim sizes and geometry were more or less the same. What made the difference was in the subtle balance of its chassis and engine.

And that balance originated in a design team lead by a man who had honed his craft by working on road racing machines for Suzuki in the 1960s: Hiroshi Nakano.

With the advent of the Muskie clean air act in the US expected to soon outlaw big two-stroke machines, Suzuki had set up a team in the late 1960s to study low-emission alternatives, with conventional reciprocating four-strokes, the Suzuki two-stroke EPIC project and rotary engines under consideration. But Suzuki had to buy time, and although

its widening range of three-cylinder two-strokes, lead by the liquid-cooled 750cc GT750 launched in 1971, would have a limited production period they could at least live off the success of their RG500 road racing machines.

By 1973 it was probably clear to Suzuki that the RE5 rotary-engined machine, planned to make its debut at the end of 1974 wouldn't be a success, not just because it was complex, thirsty and heavy. Fuel prices had sky-rocketed in the wake of the Middle East war, also making two-strokes even less appealing.

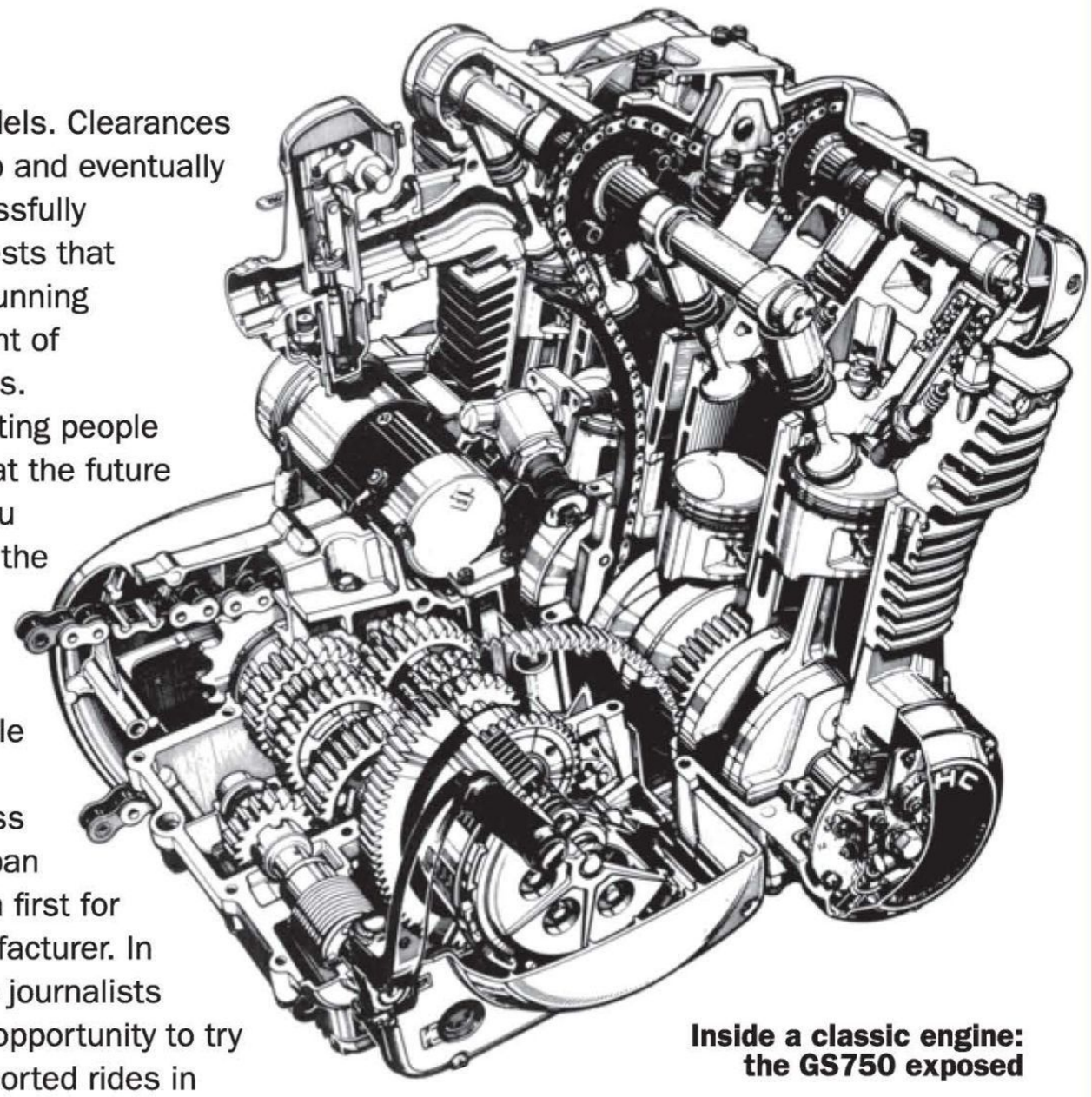
By the end of 1973, head of design at Suzuki Masa Takashi Shimizu gave the go ahead for low-emission four-stroke engines to be used and at the beginning of 1974 Nakano set to work on Suzuki's new superbike. It was code-named the GX960 and would be based on Kawasaki's 903cc Z1, but with a bigger 960cc four-cylinder engine. Nakano has since said that the top end of the Suzuki shared much of Kawasaki's double overhead camshaft design, probably because it was necessary to speed up the development process.

Less than a year later, Suzuki was forced to change direction again. At the end of 1974 new licence regulations in Japan put an upper limit of 750cc for motorcycles and a 400cc class for novices were introduced. The GX960 project was postponed in January 1975, to be replaced by one for a 750cc (65 x 56.4mm) four, along with a 400cc twin using similar design features.

While Nakano would have preferred to use a crankshaft design with plain bearings that reduced costs like Honda's engines, Suzuki had a wealth of experience with built-up cranks in its two-strokes. And it didn't have the time or cash to invest in the necessary crankshaft grinding processes to manufacture them anyway.

The use of roller bearings led to high mechanical noise on the early development models. Clearances were tightened up and eventually the engine successfully met endurance tests that involved flat-out running over the equivalent of 20,000 kilometres.

Suzuki's marketing people probably knew that the future of the Hamamatsu factory rested on the success of its new four-stroke range. To ensure that the motorcycle world got the message the press was invited to Japan to test the bike: a first for a domestic manufacturer. In the US, magazine journalists were offered the opportunity to try the GS750 in escorted rides in advance of its launch at the end of 1976.



Inside a classic engine: the GS750 exposed

Suzuki factory chiefs needn't have worried. The GS750 proved to be a revelation. But how would it perform under tougher day-to-day conditions?

My chance to test the GS750 for weekly paper Motor Cycle was in November 1976, just before the first bikes were reaching dealers' showrooms. Weather was foul, and we couldn't find a moment when the roads were dry enough for decent action photography.

We went ahead anyway, splashing through puddles and tip-toeing through roundabouts to bring readers the first report on a machine that was calculated to underwrite Suzuki's future financial security.

The headline said it all: 'Suzuki's GS750 – It's simply the quickest 750 we've tested'. True enough. At MIRA's proving ground in the Midlands, luckily in fine but dry and cold conditions the four flew down the 1000-yard timing straight to clock a best top speed of 123.30mph west and 125.29mph east, giving an average of 124.3mph.

Few experiences matched that of nailing a brand new superbike to the stop, tucking into a racing crouch as you glance past the instruments and watch as the revs climb to the redline and keep rising, the engine below singing like a banshee. At that maximum speed of more than 124mph, which Suzuki had claimed, the engine was revving to 9200rpm in top, more than I recall any previous machine.

Indeed, the GS750 had topped Honda's CB750F1 by 2mph, making the fastest 750cc machine the paper had tested. It probably would have been the quickest accelerating seven-fifty through the quarter mile as well, but for the lack of grip from the Bridgestone rear tyre.

Dropping the clutch at 8500rpm, where the engine was claimed to produce 68bhp, would just spin the rear wheel in a cloud of smoke, losing enough time to dip the mean quarter mile time to 13.5 seconds. But the bike was great to play drag racers with, singing through the gears to 9500rpm and apart from the change from first to second never dropping below 7000rpm.

Gearing was spot on for acceleration on both the track and road and eventually I found a balance that gave the best grip without lifting the front wheel too much. Even then the best average over the opposed directions was 13.25 seconds, the same as the Honda. A better measure of the Suzuki's performance was that the terminal speed was 103.50mph, 2mph more than the Honda, with the engine revving to 9000rpm in fourth.

First of the GS750 line from 1976. Opposite left is the 1978 model

I clocked 14 consecutive quarter-mile runs with the GS750 being revved, if not mercilessly, beyond the point at which I'd usually expect trouble. It returned to the start line with a regular idling speed, the double-overhead valve gear rustling happily and the clutch would once again bite smartly as I rolled off another run.

Given the top end power delivery, the engine's flexibility was also remarkable for the time. It would pull hard in top gear from 40mph and the twistgrip action of the quartet of 26mm Mikuni VM carbs was light thanks to the use of opening and closing cables.

Yet performance was just the first part of the Suzuki's qualities. The second showed immediately you swung a leg over the seat. Though of average height at 800mm (31.5 inches), it was slim along with the side panels, allowing even short-legged riders to touch the ground comfortably at a stop. Footrests were positioned in line with the seat's nose, and tucked in so you were properly positioned to enable stress-free cruising at 90mph or more, though being a bit of a purist I would have preferred a handlebar with more swept back grips.

The feeling that the bike was moulded to you immediately gave you confidence to trickle through traffic with ease. Weighing 510 pounds with a gallon of fuel, lighter than most of its contemporaries, the Suzuki offered carefree balance and neutral steering and displayed none of the awkwardness of other Japanese superbikes.

Suzuki's 16-valve GS750E for 1980 was longer with more cushy suspension (this is the US model)

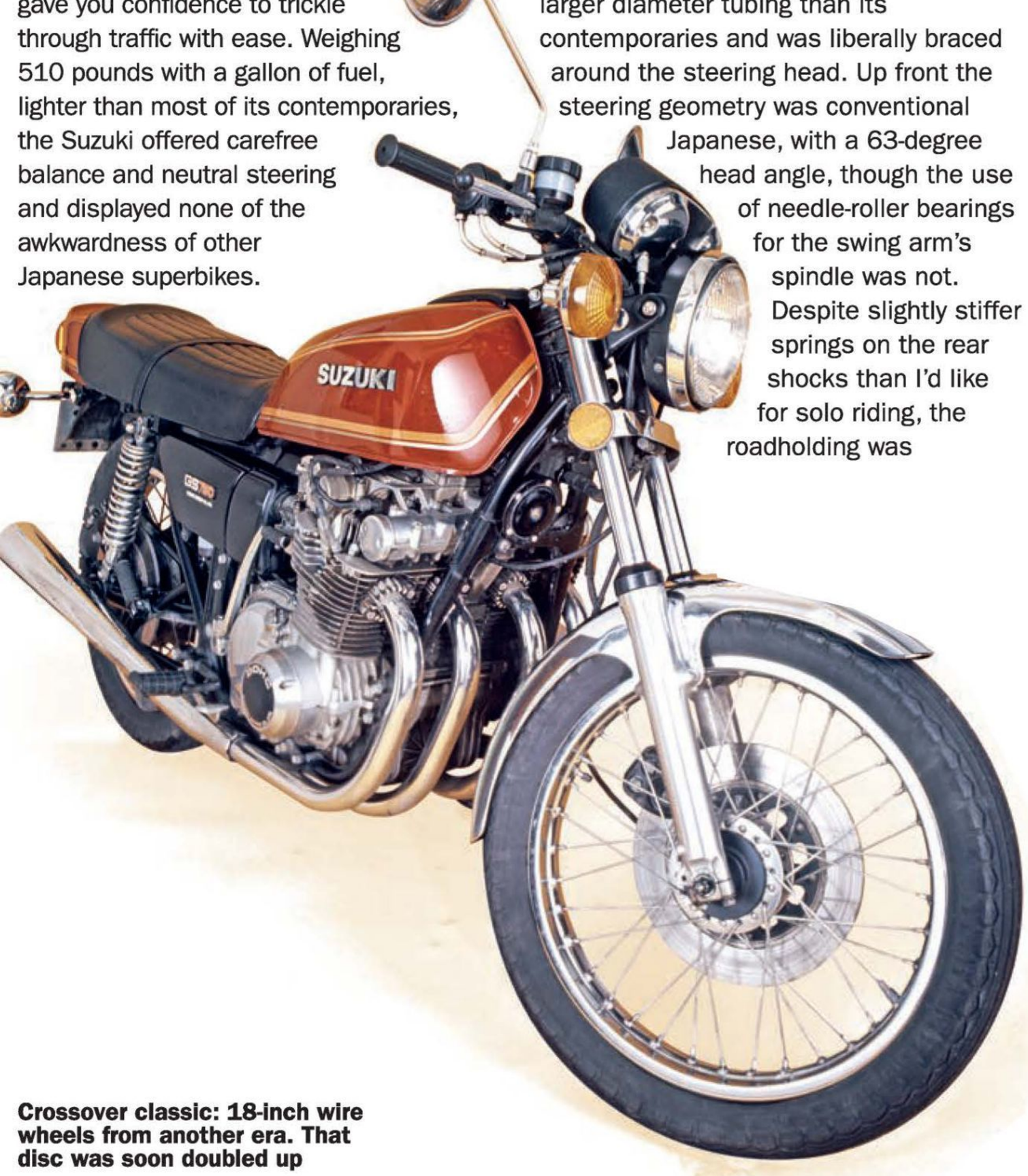
Better still, at speed the steering tautened and the bike could be carved through corners with the pipes skimming the deck without the need for effort at the handlebar or the feeling that you were close to the bike's limits of grip.

The third key quality was the Suzuki's roadholding, which was in no small measure attributable to its frame design and geometry. The duplex frame had larger diameter tubing than its contemporaries and was liberally braced around the steering head. Up front the steering geometry was conventional Japanese, with a 63-degree head angle, though the use of needle-roller bearings for the swing arm's spindle was not. Despite slightly stiffer springs on the rear shocks than I'd like for solo riding, the roadholding was exemplary for a machine rolling on conventional 19in front and 18in rear wheels with wire spokes and steel rims.

Brakes were also conventional 300mm single discs front and rear which at MIRA displayed as much controllable power as any machine I'd tested there, pulling up safely from 30mph in 7.7m (25.5ft) in the dry. Because the rear disc was the same size as the front it felt grabby and easily overheated.

That was in the dry. Suzuki, like all the Japanese manufacturers up to 1976, had yet to understand that riders used their bikes in rain in Europe and to provide a pad and disc rotor combination that worked effectively under all conditions. With the twin front disc combination used on the GS750DB soon after the bike's introduction there was some measure of improvement.

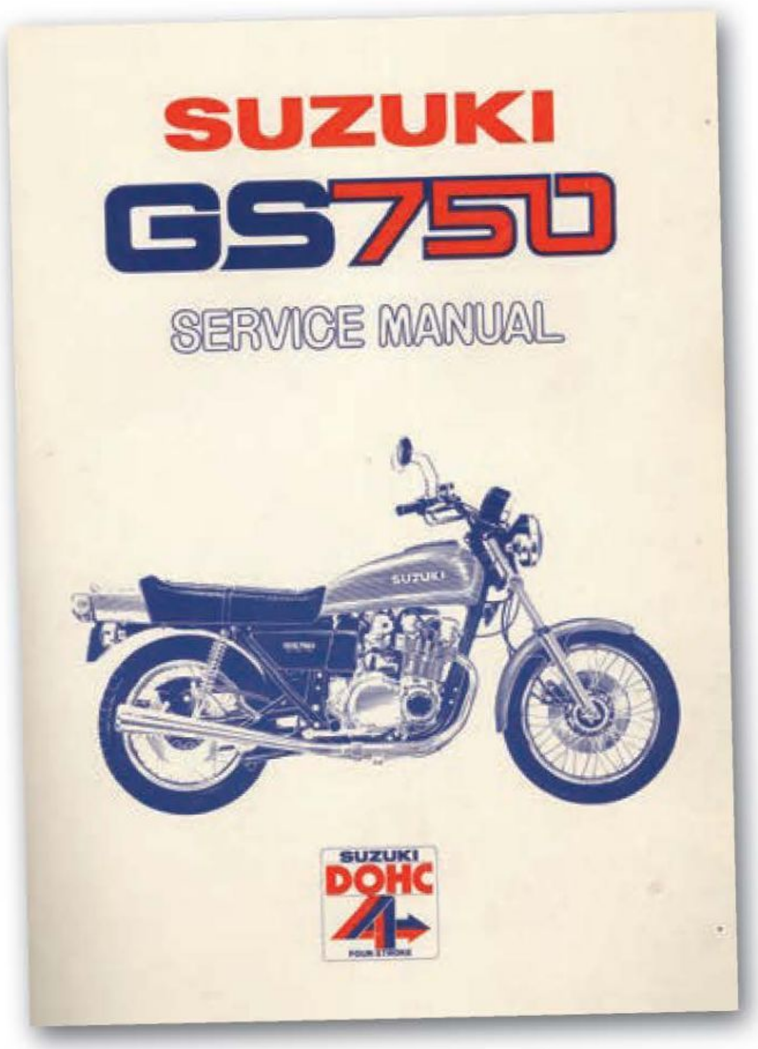
None of this, nor even the weird red glow of the instruments with their gear indicator, succeeded in taking the gloss



Crossover classic: 18-inch wire wheels from another era. That disc was soon doubled up

USEFUL CONTACTS

Data on any Suzuki:
www.suzukicycles.org
Suzuki Owners Club:
www.suzuki-club.co.uk
Parts from Crooks Suzuki:
www.crooks-suzuki.com



from a machine that was a true turning point in Japanese motorcycle design.

One of the GS750's attractions is its simplicity even when measured by the standards of the day, let alone now. It featured comprehensible contact breaker coil ignition and a charging system only slightly more advanced than British bikes (though not completely fault free) while its robust crankshaft and transmission lasted well as long as servicing is done by the book, as shown in the side story about John Keutgen's machine which he has owned for 32 years from new during which he has clocked almost 110,000 miles.

Suzuki had to improve its manufacturing practices to reduce costs and with the 1980 model year launched the revised GSX750, featuring a cylinder head using four-valves per cylinder, with the so-called Twin-Swirl-Combustion Chambers (TSCC), and a crankshaft with high-pressure lubricated plain bearings. Valve clearance was adjusted by screws on the followers.

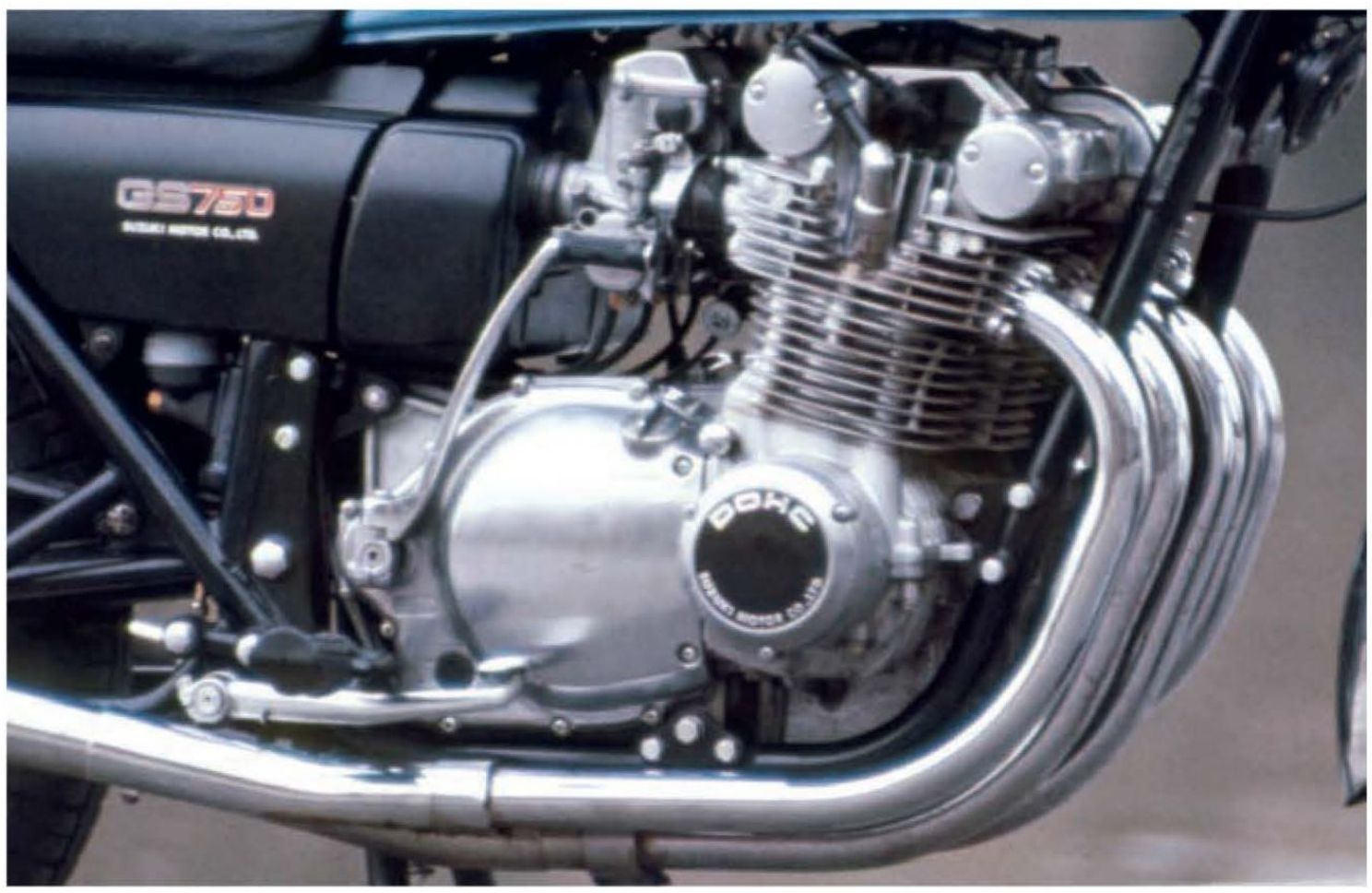
Styling was completely new with a rectangular headlamp nacelle and larger fuel tank, in common with the GSX1100 four. Wheelbase was increased further to 1529mm (60.2) inches while the front fork featured a leading-axle design to allow longer travel and increase overlap for the internal bushes.

I first tested the new 750 in California while working briefly for Cycle World magazine. Once you got over the shock of the new Suzuki's angular styling and its dubiously useful instruments such as a fuel gauge and digital gear indicator, it turned out to have a much more flexible engine, with more punch in the midrange. With a light action to the twist grip and ergonomically well-thought-out handlebar levers, the power delivery from the

SPECIFICATIONS

SUZUKI 750CC FOURS 1976-1983

Model	Suzuki GS750, 1976	Suzuki GSX750E, 1980	Suzuki GSX750ES, 1983
Engine	Air-cooled inline four	Air-cooled inline four	Air-cooled inline four
Capacity	748cc (65 x 56.4mm)	747cc (67 x 53mm)	747cc (67 x 53mm)
Valve operation	DOHC 8-valve	DOHC 16-valve	DOHC 16-valve
Compression ratio	8.7:1	9.5:1	9.6:1
Lubrication	Wet sump	Wet sump	Wet sump, 3.8 litres
Ignition	Coil and contact breaker	Electronic inductive	Electronic inductive
Carburation	Four 26mm Mikuni VM	Four 32mm Mikuni CV	Four 32mm Mikuni CV
Peak power	68bhp @ 8500rpm	80bhp @ 9200rpm	84 bhp @ 9500rpm
Peak torque	44lb-ft @ 7000rpm	46.4lb-ft @ 8400rpm	49lb-ft @ 8500rpm
Primary drive	Spur gears	Helical gears	Helical gears
Primary ratio	2.152:1 (99/46)	2.163:1 (93/43)	1.895:1
Clutch	Wet multiplate	Wet multiplate	Wet multiplate
Gearbox	Five speed	Five speed	Five speed
Internal ratios	2.57, 1.78,.1.38, 1.125 & 0.96:1	2.57, 1.83, 1.38, 1.125 & 0.96:1	2.50, 1.75, 1.37, 1.13 & 0.96:1
Final drive	530 chain	630 O-ring chain	630 O-ring chain
Final drive ratio	2.733 to 1 (41/15)	2.733 to 1 (41/15)	3.071 to 1 (43/14)
Overall ratios	15.1, 10.45, 8.12, 6.62, 5.65:1	15.2, 10.51, 8.16, 6.65 & 5.68:1	14.55, 10.18, 7.97, 6.58 & 5.58:1
Frame	Duplex tubular steel cradle type	Duplex tubular steel cradle type	Duplex semi-box section tubular
Front suspension	Telescopic fork	Telescopic leading-axle fork	Telescopic fork, preload adj
Rear suspension	Swingarm, twin shocks, 5-pos spring preload adj	Swingarm, twin shocks 5-pos spring preload adj	Light-alloy swingarm single shock, hydraulic preload adj
Front wheel	Tension spoke, steel rim, 19in	Cast light-alloy 19-inch	Cast light-alloy 2.15x16-inch
Rear wheel	Tension spoke, steel rim, 18in	Cast light-alloy 18-inch	Cast light-alloy 2.50x18-inch
Front tyre	Bridgestone 3.25H19	Bridgestone 325H19 L303	Michelin A48 100/90V16 tubeless
Rear tyre	Bridgestone 4.00H18	Bridgestone 400H18 S714	Michelin M48 120/90V17 tubeless
Front brake	Single 300mm (11.75in) disc	Dual 275mm (10.8in) discs	Dual 260mm (10.25in) discs
Rear brake	Single 300mm (11.75in) disc.	275mm (10.8in) disc	260mm (10.25in) disc
Electrical system	Alternator 190W, 60/55W quartz starter motor, indicators	250w alternator, 60/55W headlamp starter motor, indicators	Alternator 310W, 60/55W headlamp starter motor, indicators
Battery	12v 14Ah	12v 14Ah	12v 14Ah
Fuel tank	18 litres (4 gal)	24 litres (5.3 gal)	22 litres (4.8 gal)
Wheelbase	1490mm (58.7in)	1530mm (60.2in)	1480mm (58.3in)
Seat height	800mm (31.5in)	825mm (32.5in)	800mm (31.5in)
Castor angle	63.0 deg	62.0 deg	62.2 deg
Trail	107mm (4.2in)	103mm (4.05in)	105mm (4.13in)
Weight (claimed)	222 kg (492lb)	233.5kg (514lb)	210kg (462lb)



The original GS750's engine design was based heavily on Kawasaki's Z1

Freaky red glow from the otherwise excellent instruments

shorter-stroke 747cc (67x53mm) engine felt both smooth and particularly lively from lower revs, which belied the higher claimed peak power of 80bhp at 9400rpm.

The relaxed power delivery made the Suzuki pleasant to ride over long distances, which were more easily achieved because it was more economical, with up to 51mpg, and had a larger 24.1 litre (5.3 gallon) fuel tank, giving a range of more than 250 miles.

Even when set up for the UK market the handling was more suited to touring rather than sporty riding, with a long 1529mm (60.2 inch) wheelbase and soft suspension, despite the spring specifications having been stiffened.

The front fork suffered from lack of torsional rigidity and that also made the GSX750E slow to respond when pitching into corners. They often bottomed out during hard braking, but otherwise the slotted discs offered more than ample stopping power.

The next incarnation of Suzuki's 750 was in 1983 when it was completely revised along with all the four-cylinder range, dumping the angular look with engines specifically designed for each class.

CELEBRITY CLASSIC

Almost 20 years ago, we featured John Keutgen's Suzuki GS750DB as something of a celebrity classic for, even then, the 12-year-old machine had clocked almost 100,000 miles in day-to-day use.

As an electrical engineer for Independent Television News living in North London, John had been using the bike for commuting along with yearly trips to the Isle of Man TT and to road race meetings as an ACU timekeeper. Following his concerns about the dealer's servicing capability after he bought the bike in May 1978, he carried out the maintenance meticulously himself, all the while keeping a detailed record of everything he'd done, along with key information like valve clearances and compression pressures.

To say that the regime enabled the bike to be perfectly reliable would overstate the case, but it meant that John could reasonably predict what needed to be carried out at each 3000 mile stervice. Along with the replacement of drive chains and sprockets at between 21,000 and 28,000 miles, a rate that he attributes to a daily spray with WD-40, tyres lasted between 6000 and 10,000 miles for the rear and between 10,000 and 27,000 miles for the front.

John changed the oil and filter every 1500 miles, gave it a thorough check at 3000 miles, when the valve clearances were corrected, which was a predictable process because of his records.

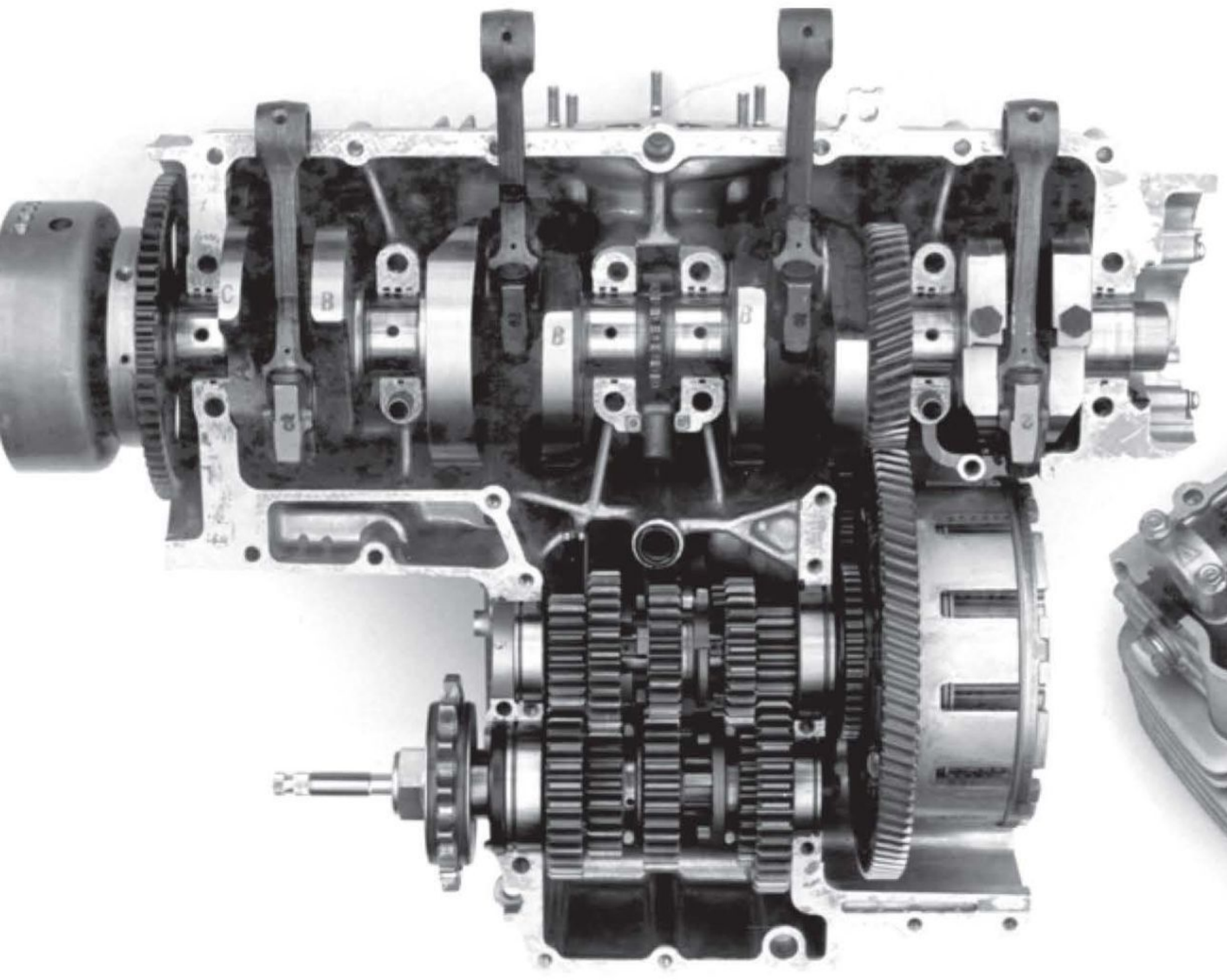
Only time the cylinder head was lifted was to replace the head gasket which had failed, he thinks, because the head wasn't torqued down correctly at the first service. Other problems were minor, such as a faulty condenser in the original contact breaker ignition, and when one of the rectifier circuits failed. "One of the condensers went open circuit intermittently and I originally thought it was two cylinders going rich," recalls John. "Then it stopped on the way to the Isle of Man, and came on again and was OK all the way back. I checked the condensers and replaced the faulty one with one from my own stock."

John Keutgen with his 100,000-mile GS750

Silencers corrode at their exits, and John had used four sets by the time it reached 100,000 miles. Yearly mileage dropped after John bought a GSX1100F in 1990 which he's still got. But he also still owns the GS750DB, 32 years on. "It doesn't do a lot these days since I retired 11 years ago. Not having a car it's useful to have if there's a problem with the GSX1100F, which has done 65,000 miles."

The GS750DB is in much the same condition it was in 1991, but now with 110,000 clocked up. "I've also fitted a Cibie headlamp and 'pedestrian shifter' horns. But it needs another chain and sprocket change and the seat needs recovering.

"It's really a part of the furniture now. I'm one of those people who get attached to things," he says.



Inside the 16-valve GSX750: shell main bearings and rocker camshaft followers

The GSX750ES had a lighter and more compact engine that allowed the light-alloy swing arm to be longer and the single-shock suspension to be included within the shorter 1480mm (58.3 inch) wheelbase.

Internal engine dimensions were unchanged but power boosted to 84bhp at 9500rpm by the use of bigger paired valves (inlet up from 23 to 25mm and exhausts up from 20 to 21mm) and lift increased from 6.5 to 7.5mm. To control engine temperature, the oil cooler was enlarged and jets sprayed lubricant on the underside of the pistons.

Suzuki had adopted a 16-inch front wheel with a wider tyre across the range along with a novel single shock (called Full-Floater) rear suspension in which the low mounted shock was compressed from both ends by the movement of the alloy swing arm. Conveniently, the spring's preload was hydraulically adjusted via a remotely mounted bezel. Damping adjustment had four positions. Again following fashion, the front fork had spring preload adjustment and anti-dive valving on both legs operated by brake line pressure. Weight was cut to a dry 219.5kg (484lb).

It was in a way a return to the values of the original GS750, though in a more modern package. Tested against Honda's VF750F and Kawasaki's GPz750, for all round civility I preferred the Suzuki. Its better ergonomics, flexible engine and neutral, flickable steering conspired to make it a willing partner in almost any going.

Braking could have been better, as could the Michelin tyres but the handling was good enough to compensate for either, and in any case more grippy rubber, pads and lines could be fitted.

With perceptably more power through the rev range, which topped out at 10,000rpm, the GSX750ES offered stronger acceleration, and with better aerodynamics from the vestigial fairing it was more comfortable at speed, as shown by the top speed conventionally seated of nearly 122mph shows (the original GS750 topped out at 108mph under the same conditions). Strangely though the top speed improved by just 3mph to 127.46mph through MIRA's timing lights, even though gearing was about the same.

Acceleration was much quicker though, and the GSX750ES zipped through the quarter-mile in 12.18 seconds with a terminal speed of 107.66mph, more than a second and 4mph up on the 1976 GS.

By the time the GSX750ES was established Suzuki's engineers were well on their way to upsetting the motorcycling apple cart with the ultra-lightweight GSX-R750, which appeared in 1985.

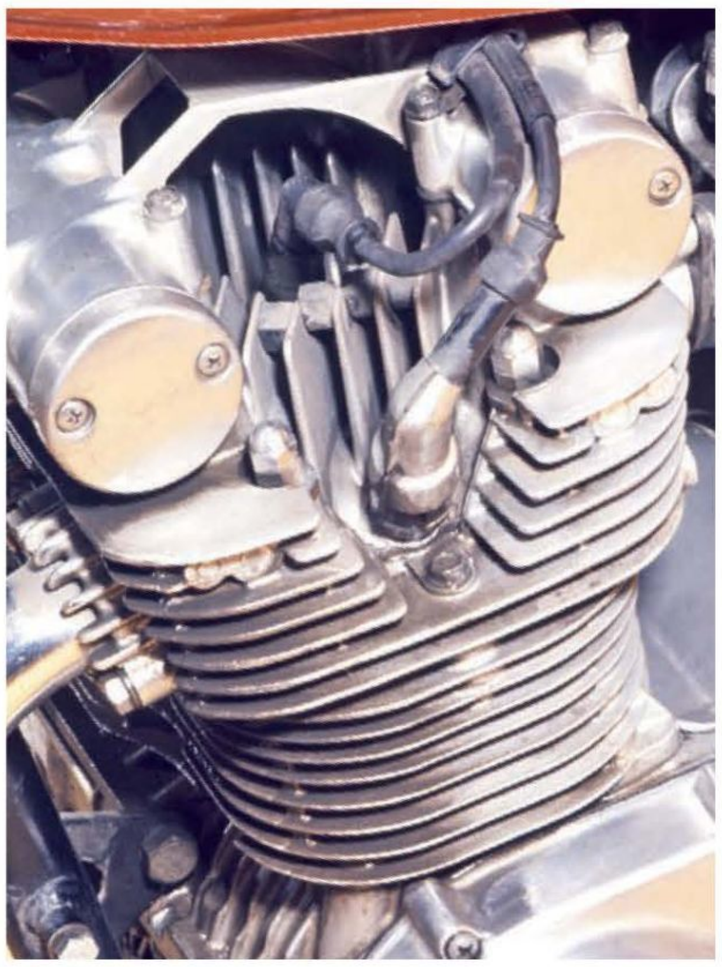
That marked the end of an era connecting modern superbike technology with the GS750's, which was rooted in the early superbike period of the early 1970s.

If you like your Japanese classics simple and stylish, the GS750 is as good, and as long lasting, as they get.

SUZUKI GS750 FOURS PERFORMANCE

All figures compiled at Motor Industry Research Association's proving ground, Nuneaton, Warwicks

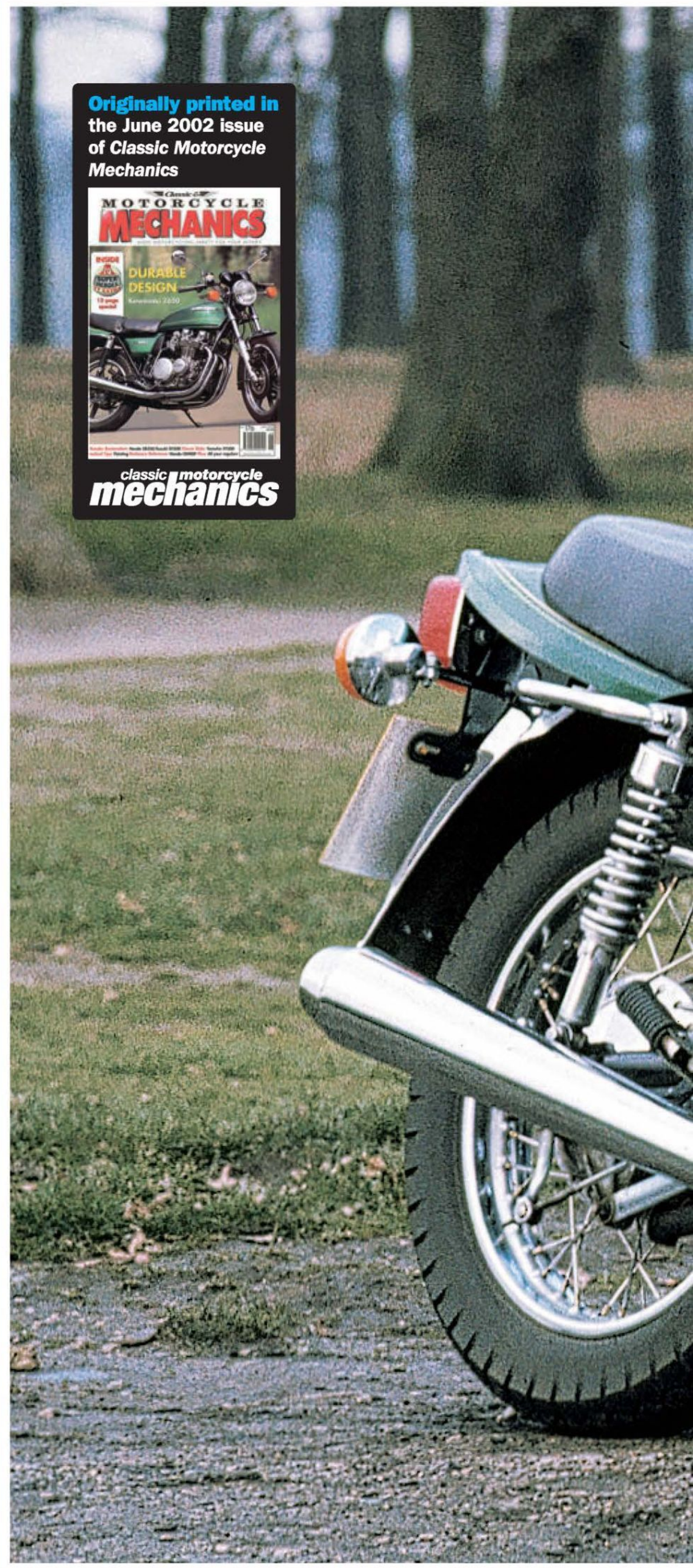
Model	GS750	GSX750E	GSX750ES
Date of test	23 Nov 1976	1980	29 April 1983
Mean top speed	124.30mph	128mph (est)	127.46mph
Best one-way	125.29mph	130.59mph	
Mean normally seated	108.45mph	121.86mph	
Standing quarter-mile (mean)	13.25s/103.44mph	12.4s/105mph	12.18s/107.66mph
Speedo accuracy, actual mph at indicated			
30mph	26.57	na	27.8
50mph	44.10	na	47.8
70mph	60.46	na	68.5
Test weight (1gal fuel):	510lb	514lb dry	525lb
Overall test fuel consumption	46.7mpg	44.3mpg	45.2mpg
Speeds in gears at max power revs			
	@8500rpm	@9500rpm	@10,000rpm
	43mph	46mph	50mph
	62mph	66mph	72mph
	80mph	85mph	92mph
	98mph	105mph	112mph
	114mph	123mph	132mph



Bulletproof design

Standing the TEST OF TIME

Kawasaki's current aircooled, dohc, 750cc four is one of the longest-lasting designs in motorcycling, originating 26 years ago in the Z650. John Nutting was there at its birth and analyses just why the 650 remains so popular.



KAWASAKI'S Z650 four, produced from 1976 to 1983, has been featured frequently in recent issues of *Mechanics*, and not without good reason. We covered the machine's history in 'Buying Bikes' in September 2001 while John Thorpe recalled his experiences with a model bought in 1977 for a long-term test on *Motorcycling Monthly*.

Potent, compact and durable, the Z650 was more than just a smaller version of the 903cc Kawasaki Z1 launched four years earlier. It was a chance for project design chief Gyoichi 'Ben' Inamura, father of the Z650, to show that the factory could produce both fast and agile four stroke motorcycles.

Few at the time could have realised just how durable Ben's design would be. In fact, the four cylinder engine he penned has proved to be one of the longest-lasting of any from a Japanese factory. The ZR750 that stayed in production still employs the same basic engine layout. Between the Z650 and today, the unit has been used in the Z750, the GPz750, the GPz750 Turbo, the shaft-drive GT750, the 'retro' 750 Zephyr and countless custom models. Amongst its various forms the engine has been tuned to outputs of up to 100 bhp. It is seemingly bulletproof. No wonder the original version is regarded so highly.

The Z650's designer, 'Ben' Inamura, enjoys the benefits of the press launch in Edinburgh.

But what made it so solid and versatile? It is suggested that 1976 was a vintage year for new models but the year before had been better, with the introduction of Honda's Gold Wing and the CB400F. True, Suzuki had launched the GS750 towards the end of 1976, but it was the only other really new bike.

Words/Pictures: John Nutting

Following the first flush of Japanese machines in the late Sixties and early Seventies, we'd been starved of anything really new since the Kawasaki Z1 and Honda CB500 Four were revealed at the end of 1971.

Kawasaki's master stroke with the Z650 engine was to combine a modern, for the time, bottom end with a high-performance cylinder head. The importance of this cannot be understated. The 903cc Z1 engine used a fabricated crankshaft with roller main and big end bearings, plus a gear primary drive. It was incredibly strong and not dependent on high pressure lubrication, but for mass production it was expensive to manufacture. Suzuki took this safe option with its almost identical GS750.

For the CB500F, Honda's designers had taken a long-term view with a crankshaft and transmission layout that offered lower-cost features such as a one-piece forged steel crankshaft and a primary drive that separated the spur gears from the crank, which drove through an inverted-tooth chain.

Kawasaki's project chief Inamura used the same layout for the 650cc engine, which was not much larger than

Kawasaki Z650

It's got to be green! The original Z650 had only one flaw - that single front disc. Many owners convert to the later twin disc set-up.

Honda's 500, and then topped it off with a cylinder head featuring double overhead camshafts that opened the valves directly through bucket-type followers.

But why was it a 650cc unit? For those in the UK, where an insurance break at 600cc had differentiated the traditional 650cc twins from the 500s, this seemed strange because 750cc machines had become commonplace. Perhaps Kawasaki was aware of the coming Suzuki 750 and wanted to be different. Or Kawasaki was playing safe, knowing that there was development potential in opening the engine up to 750cc at a later stage.

John Nutting (left) chats to Kawasaki UK boss of the day, John Norman, in the hills south of Edinburgh during the gloriously sunny press launch.

Either way, the Z650 set a new standard and with a maximum 64 bhp on tap at 8500 rpm, offered the highest power per litre (98 bhp) of any 500cc-plus motorcycle. (The best 250cc two strokes were already at 120 bhp per litre.)

As aircooled engines go, it was pretty compact with a bore and stroke of 62 x 54mm, single inlet and exhaust valves and a quartet of 24mm Mikuni carburettors. The combustion chamber design enabled a compression ratio of 9.5:1 but the engine ran reliably on unleaded fuel. Solid-state electronics were still in their infancy at the time, so the ignition used traditional coils and contact breakers.

There was nothing earth-shattering about the chassis. The wheels had wire spoked steel rims with 325 x 19 and 400 x 18 Japanese Dunlop tyres. But it was shorter than normal with a 56.5-inch wheelbase. This might have provoked waywardness in previous Japanese machines except that this one came with a well-braced duplex tubular steel frame, a lower seat height and steering geometry (63 degree rake and 4.25 in trail) that provided both neutral steering and stability at speed.

Proper press launch

SO confident was Kawasaki in its new baby that it was the first of the Japanese factories to invite the press to the type of 'proper' launch that motorcycle publications now take for granted. The venue was the little racing circuit at Ingliston near Edinburgh in Scotland and roads in the surrounding countryside. The track proved to be ideal for the bike which, with a combination of snappy acceleration and good cornering clearance, showed that good handling was no longer the preserve of British or Italian bikes.

Some, including Italian hot-shoe Nico Cereghini who had been doing well in the world endurance championships, might have preferred stiffer suspension but, as we found on the country roads, the Z650 was pretty well balanced for everyday sporting use.

Notes made during the following road test sum up my conclusions. "You can skim through bends much more confidently than the Z900 or Z1000 would ever allow, and with none of the gut-churning high-speed wobbles that still mark the Z1000 as a bike to be respected when the going gets hot.

"The main improvement on the Z650 is a stiffer frame and more sensibly-designed steering geometry. The bike is very stable in fast bends while at low speeds there is only the slightest hint of oversteer - a feeling that the bike wants to drop further into a corner. And unlike the Z900, it does not want to straighten up when cranked over in fast corners."

If there were any doubts that a little 650 could cut the mustard with bigger 750cc machines, they were firmly silenced the following March. At Daytona Beach, a week or so before Speed Week, Kawasaki launched an attack on the world 750cc endurance speed records with a trio of mildly tuned machines.

They came away with a fistful of records that would have done credit to a 1000cc machine of the time, let alone a 650. The highest record speed was for the AMA (American Motorcyclists Association) 100-miles at 130 mph, followed by the FIM 1000km at 128.4 mph and the AMA/FIM six-hours at 127.7 mph. Proving the bike's durability, the team ran it for 24 hours around Daytona's speed bowl at a record average of 117.2 mph.

Just a delight

SOON after, as road tester for the weekly newspaper *Motor Cycle*, I collected Kawasaki UK's road test Z650. For day-to-day use it was a delightful machine: reliable, responsive, smooth, comfortable and practical, but with one glaring flaw that would show itself later.

If I thought the bike quick on the road, it hadn't prepared me for the surprise in store when I took it to the Motor Industry Research Association's proving ground near Nuneaton.

The routine was the same as usual. After checking the speedometer through the 1000-yard straight's light-beam activated electronic timing gear, I rode to the end of the western end of the bitumen, turned and wound the engine through the five gears, tucking in behind the instruments.

It broke the lights at 119.6 mph with 9500 rpm showing on the rev counter. Uphill and against a ten mph breeze the speed was just under 117 mph.

But there was more to come. Following runs provided a best one-way speed of 121.24 mph and an average for both directions (to offer a meaningful comparison with other machines) of 119.57 mph. To illustrate just how remarkable this performance was, on the same day I tested a Seeley Honda 750 that only averaged 114.8 mph.

If Kawasaki's claim that the Z650's power peak was at 8500 rpm, clearly the bike was undergeared and it's likely that it could have gone faster with an extra tooth on the gearbox sprocket. But during the acceleration tests I found that the gearing was almost perfect for the quickest-possible quarter mile times. With an average time for the standing 440 yards of 12.9 seconds and a terminal speed of 101.59 mph, the Z650 wasn't far short of the Z1000's figures of 12.65s/105.5 mph. But in the first 110 yards from a standstill the 650 was a rocket, reaching 66.8 mph. The only other bike to beat this was Kawasaki's first - and most potent - Z1 of 1973, which clocked 68 mph. By 1977, the Z1000 could only manage 64.3 mph. For stop-light racing, the Z650 was the bike to have.

Simple cockpit layout typical of the time.

Yet it was a good all-rounder. Capable of revving safely to 10,000, the Z650 was just as happy to pull strongly from 4000 rpm. It was smooth too, and apart from a rough patch at 7000 was a silky as any four, particularly at 5500 in top which conveniently equated to 70 mph.

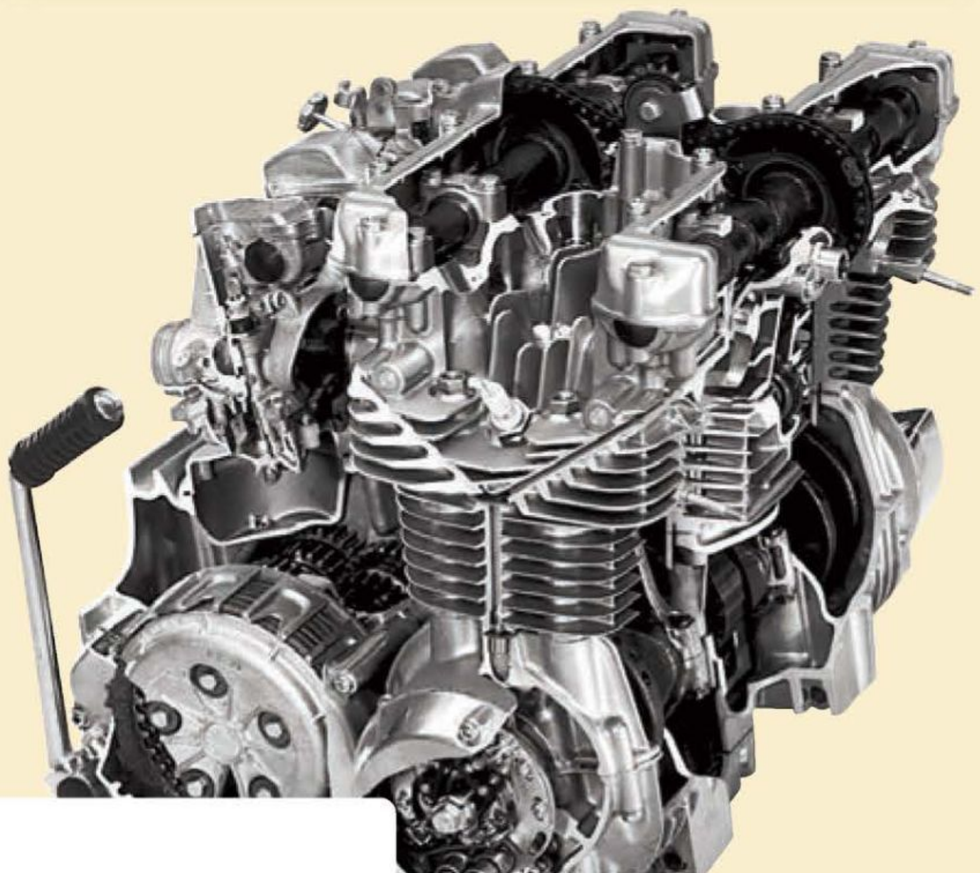
Neither was the bike heavy on fuel. During commuting, it returned 52 mpg but the performance testing dropped the consumption to 34 mpg for an overall average over 600 miles of 46.5 mpg. Range with the 3.5 gallon tank was between 150 and 160 miles.

Dubious braking performance in the wet was the Z650's only flaw. Equipped with a single stainless-steel front disc and rear drum, the Z650 suffered like most Japanese

1978, and the new C model sports twin discs up front, special paintwork and mag wheels.

Kawasaki Z650 specification

MODEL	Kawasaki Z650-B1
ENGINE	Aircooled transverse four
CAPACITY	652cc (62 x 54mm)
VALVE OPERATION	Chain-driven double overhead camshafts
COMPRESSION RATIO	9.5 to 1
LUBRICATION	Wet sump, 3.5 litre capacity
IGNITION	Coil and contact breakers
CARBURATION	Four 24mm-choke Mikunis
PEAK POWER	64 bhp at 8500 rpm
PEAK TORQUE	41.9 lb-ft at 7,000 rpm
PRIMARY DRIVE	Inverted-tooth chain & gears
PRIMARY RATIO	2.55:1 (27/23 & 63/29)
CLUTCH	Wet multiplate
GEARBOX	Five speed
INTERNAL RATIOS	2.33, 1.63, 1.27, 1.04 and 0.89 to 1
FINAL DRIVE	5/8 x 3/8in 530 chain
FINAL DRIVE RATIO	2.63:1 (42/16)
OVERALL RATIOS	15.6, 10.9, 8.5, 6.96 and 5.95 to 1.
FRAME	Duplex tubular steel cradle
FRONT SUSPENSION	Telescopic fork
REAR SUSPENSION	Pivoted fork, two spring-damper units with five-position adjustable preload.
FRONT/REAR WHEEL	Laced spoke, steel rim
FRONT TYRE	Dunlop Gold Seal F6, 3.25H-19
REAR TYRE	Dunlop Gold Seal K87, 4.00H-18
FRONT BRAKE	298mm (11.75in) disc front, floating caliper
REAR BRAKE	178mm (7in) drum
ELECTRICAL SYSTEM	Alternator 280W, 45/40W headlamp, starter motor
BATTERY	12V-10AH
FUEL TANK	16.8 litres (3.7gal)
DIMENSIONS	Wheelbase 1435mm (56.5in), seat height 813mm (32in), castor angle 63 degrees, trail 108 mm (4.3in), weight (dry, claimed) 211kg (465lb)



The same basic engine design of the Z650 still survives in the aircooled 750cc four in the Kawasaki model range today.

machines of its time. This was partly corrected with the Z650-C1 (Custom) model launched during 1977 with dual front discs using calipers mounted behind the fork legs, and light-alloy seven-spoke wheels.

The Z650-B2 for 1978 also had a revised caliper position, but still only a single disc. Other changes (according to my Kawasaki Recognition Manual published in 1978) included needle-roller swingarm bearings, revised carburettor settings and generator (two-phase rather than three-phase), a diaphragm fuel tap and four-way flashers.

The camchain tensioner was also changed to an 'automatic' unit. It wouldn't be until the 1979 model year that Kawasaki would introduce 'all-weather' sintered disc pads to improve braking in the wet.

The Z650 Custom was tested in May 1978 but failed to match the performance of the original. Average top speed was 117.89 mph while the quarter mile time was 13.7 seconds with a terminal speed of 97.32 mph.

When the Z750 was introduced in 1980 it featured everything that a Z650 might have wished for; hugely improved performance from the 74 bhp peak power, adjustable suspension and much more in essentially the same compact package. But it was more peaky and perhaps wasn't quite so stylish: owners are particular about the original styling and didn't like the 1978 model colours.

Green and mean, that's the way they like 'em, even after more than quarter of a century.

Owner's stories

DAVID Laver, 49, of Harefield, Middlesex, writes about his Kawasaki 650; "I have a 1976 Z650 with 47,000 miles on the clock. I love it to bits. It's a bit hard to start but from then on it runs like a clock. I've had a few other bikes: many years ago I had a Honda C72 250cc twin.

"The next was an RD350 bought about three years ago. I loved that but it blew up and at the same time another bike crashed into me, writing it off.

"With the insurance money all I could afford was an old BMW R65. It got me to work. What else can I say? I still have the BMW but don't know what to do with it.

"The Zed is really great. I use it to get to work in all weathers, visit friends on it, go to bike fairs and local bike meets.

"It gives about 50 mpg, out-accelerates the old Elsie and makes me grin every time I ride it. It's easy to service and bits are cheap. It's rough, not pretty. That's because I'm lazy. I am more concerned about engineering than looks. I get ragged a lot at work because it is yucky.

"It's very original, except it has no kickstart and now has GPz ignition. I would like mag wheels and a small screen for the cold mornings."

TAMZYN Sunderland, 30, from London, writes about her Z650; "I purchased my Z650 in 2000 as an Italian import (only the green would do!). I always wanted one because it's a nice looking machine, and well proportioned.

"The first thing I did before anything else was to get a set of UK carbs for it because it ran like a dog; it wouldn't idle and pulling away from a standstill was a joke! It also guzzled fuel.

"I'm very pleased with the handling and the smooth gear changes. It's very responsive in all areasand likes to be wound up in all gears. Very nippy. Brakes are good even though I have only one disc. Others owners I know have converted theirs to twin discs.

"Genuine Kawasaki spares are very expensive so it's worth shopping around. I have managed to get a lot of spares from America such as chrome bits (rear mudguard is shorter in the USA), engine guards, plastic, etc."

Kawasaki Z650 recognition features

YEAR	MODEL	FRAME NO	FEATURES
1977	Z650-B1	Z650B-000001	652cc dohc four, 64 bhp, 495lb.
1978	Z650-B2	Z650B-027501	Colour changes, reversed disc caliper, auto cam chain tensioner, needle roller swingarm bearings, two-phase generator, diaphragm fuel tap, combined rectifier and regulator, hazard lights.
1978	Z650-C2	KZ650C-010001	Metallic silver paint, light-alloy wheels, twin front discs, disc rear.
1979	Z650-B3	KZ650B-046201	Return to original 1976 colours.
1979	Z650-C3	KZ650C-022801	All-weather disc pads. New panel badges.
1979	Z650-D2	KZ650D-010601	Custom SR model with more chrome, including rear mudguard, revised exhaust system, 16-inch rear wheel.
1980	Z650-D3	KZ650D-026001	Colour and graphics changes.
1980	Z650-F1	KZ650F-000001	Revised B and C model with alloy wheels and drum rear brakes.
1981	Z650-F2	KZ650F-007201	Incorporates Z750 features including front wheel and brakes, black finished engine, CDI. Kick-start lever removed.
1981	Z650-D4	KZ650D-028101	SR version of the F2.
1982	Z650-F3	KZ650F-012401	Larger 32mm CV carbs and air-box from Z750.
1983	Z650-F4	KZ650F-014301	Outer cases similar to Z750L. Z650H (CSR) model offered outside UK.

Kawasaki Z650 performance data

All figures compiled at Motor Industry Research Association's proving ground, Nuneaton, Warks.

MODEL:	Kawasaki Z650	Z650 Custom
DATE OF TEST:	28 March 1977,	31 May 1978
REG NO:	RMY 902R	XLR 181S
CONDITIONS:	Fine, 40 deg F, 10mph tail wind	Warm, calm, light headwind
MEAN TOP SPEED (MPH)	119.57	117.89
BEST ONE-WAY (MPH)	121.24	120.34
MEAN NORMALLY SEATED (MPH)	103.71	105.27
STANDING QUARTER-MILE: (MEAN, SECS/MPH)	12.9/101.6	13.7/97.32
ACCELERATION (SECS/MPH) 110, 220, 330YARDS	5.20/66.8, 7.80/84.3, 10.9/94.5	5.3/66.6, 8.5/81.3, 11.4/90.1
CONSTANT SPEED MPG@MPH 30, 50, 70	75.2, 67.2, 48.0	72.0, 65.6, 48.0
BRAKING DISTANCE (FEET) (FROM 30MPH)	29.25ft	28.0ft
TURNING CIRCLE (FT)	15.5ft	15.25ft
SPEEDO ACCURACY, ACTUAL MPH AT INDICATED: 30, 50, 70, 90	28.6, 46.2, 63.3, 84.3	27.5, 46.8, 66.3, 84.8
TEST WEIGHT (1GAL FUEL):	495lb inc 1 gal of fuel	
OVERALL TEST MPG	46.5mpg	na

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BALANCE OF POWER

At the dawn of the 80s the choice of 750cc sportbikes was limited to conventional in-line fours from Honda, Kawasaki and Suzuki. But despite accusations that the Universal Japanese Motorcycle was becoming all too common, the factories were producing some distinctive bikes. John Nutting rode three of the best.

There once was a time when 750s were regarded as the pinnacle of motorcycle power and prestige. Ownership of a CB750, one of the Trident or Rocket triples, or – in hushed tones this – a Kawasaki Mach IV, implied the ultimate in cool. With three or four cylinders roaring below, even the weediest nerd could summon an image of barely disguised rippling muscles, a diet of raw bones and with a queue of dribbling pubescent babes in tow.

But rather than refine the 750s through the decade of the 70s, the Japanese factories satisfied the market's lust for power with litre-plus models, and the smaller bikes were eventually despatched as passé.

Again the biggest bikes ruled the roost. But in time the 750s again evolved, and by 1983 were offering comparable performance and, more importantly, niftier handling that enabled them to run rings around the heavyweights. Eventually road racing adopted 750cc machines as the premier class (predating the current 800cc MotoGP class by 20 years, showing that there's nothing ever really new)

It took a while for the Japanese factories to get there. Development is by necessity an incremental process with only rare flashes of dramatically new machines.

In 1980, manufacturing considerations continued to influence how motorcycles were marketed. To reduce costs, components were used across a factory's range and, where possible, the same basic engine castings were used for up to three different capacity classes.

RAW AND LEAN

Honda's 16-valve CB750F was almost identical to the CB900F which had been launched in 1978. At the time in the European market the bigger 902cc four had been augmented by the CB750K with four silencers and different styling. The CB750F was initially launched as the ultimate sporting tool in the US (where the 900 wasn't sold), only reaching Europe two years later.

Because its engine used a smaller 748cc capacity (from a 62x62mm bore and stroke), it could be argued that the CB750F was needlessly more bulky and heavier than it need be, but in fact it still felt as raw and lean as the 900, the only obvious external difference, apart from the colours and graphics being in the use of a conventional tubular steel rather than clip-on handlebar.

Suzuki's GSX750E had been launched at the end of 1979 alongside the bigger GSX1100E. Both were completely new machines intended to replace the GS750 and GS1000 fours that had been in production for three and two years respectively.

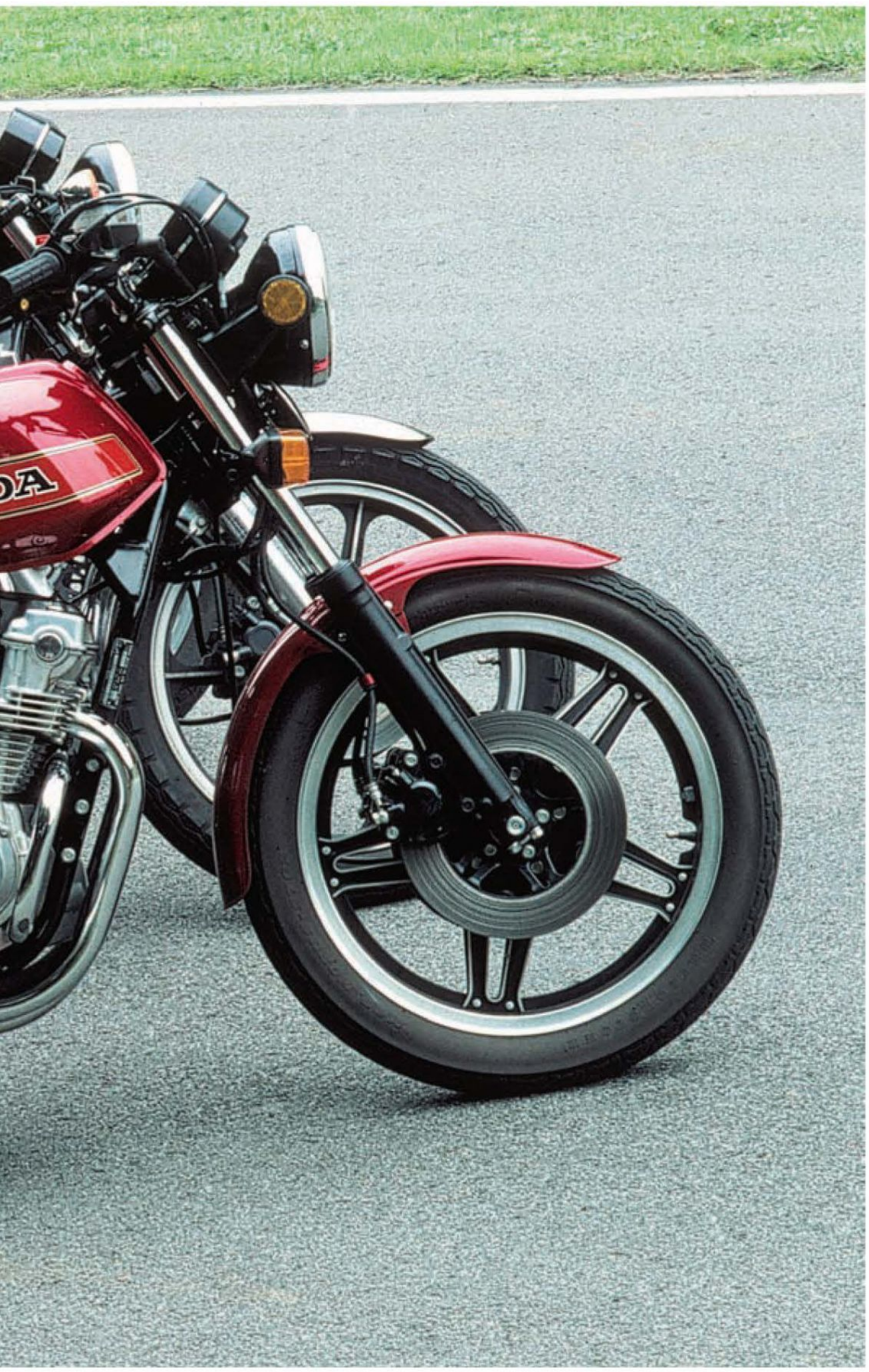
The GSX designation pointed to the use of four valves per cylinder, as in the CB750F's engine, but with a new twist: Twin Swirl Combustion Chambers (TSCC) in which the paired inlet and exhaust valves were positioned to provide a more compact combustion chamber that allowed a higher compression ratio.

Otherwise the 750cc Suzuki looked, apart from a couple of small details, just like the 1075cc model with its huge rectangular headlamp nacelle and a long 60.2in wheelbase.

CONTRASTING APPROACHES

The Kawasaki Z750 had a lean bloodline, being in effect a bored-out version of the Z650 four, a machine that had already wowed the motorcycling fraternity four years earlier in its ability to just-about keep up with bigger bikes both with its ton-twenty top speed and outright agility. In theory the 750cc version was expected to be a better all-round prospect because it was lighter and smaller than its class competitors.

Otherwise the three bikes were similar with four-cylinder double-overhead-camshaft five-speed engines in duplex tubular-steel frames with 19in and 18in wheels and triple disc brakes. But that's



DEVELOPMENT AS A MARKETING TOOL

Motorcycle manufacturers rarely, if ever, launch new machines that are as good as they can make them. New models are part of an overall marketing plan that provides for yearly upgrades before significant design changes become necessary.

That way, each year the sales people have details to eulogise about. Production considerations also have to be taken into account. Although the development of new models is easier through the use of computer-aided-design in which prototyping takes days rather than years, the cost of manufacturing tooling still has to spread over a number of years.

That's why even the best Japanese factories don't change models more frequently than every four years. In between, styling changes mark each year and the power delivery is altered to make the machine feel different. One year the power is at the top end of the range, making it peaky and exciting. Next year, the engine gets more mid-range for better low-end response. And vice versa.

Then, more often than not, specific engine architectures are used for two or three capacity classes. For this reason alone motorcycle models from the leading factories are a design compromise. They're either slightly too heavy, because a smaller capacity machine is derived from a larger one, or too cramped when a larger engine is squeezed into a smaller one.

Of course there are exceptions. Suzuki's GSXR750 in 1985 was launched as a pure sports machine with a 100bhp 750cc engine in a lightweight 375lb chassis. It was so exciting that Suzuki could only improve it by making it safer and more dull in subsequent versions. The 1100cc version revived the process. Then at the beginning of the 90s Honda's CB900 Fireblade used a similar tactic, but again later refinement reduced its initial impact.

By the end of the 70s, the Japanese factories were just beginning to get wise to the need for more than subtle design updates to keep riders interested with each new model year. Model ranges were complete, from 50cc lightweights through to 1300cc Superbikes. Features such as cast-alloy wheels, reasonably reliable disc brakes, passable suspension and tubeless tyres were common on all bikes. Colours and graphics changed for each model each year to provide an element of drama.

In the 750cc sports class of 1980 there were three main contenders from Japan: Honda's CB750F, Kawasaki's Z750E and Suzuki GSX750E. (Yamaha's shaft-drive XS750 triple and XJ750 four were regarded as tourers, so weren't contenders).

All three machines could be regarded as derivatives of machines from other classes. The Honda was from a platform that included the CB900F and, soon after, the CB1100F. The Suzuki was basically a smaller-capacity version of the GSX1100E. The Kawasaki, a larger-capacity version of the Z650 launched in 1976, was probably the only one of the three that was optimised for its weight and size.

as far as it went. In every other way the 750cc models from Honda, Kawasaki and Suzuki were about as different as they could be.

Testing all three side-by-side for Which Bike? magazine in the summer of 1980 – though without the benefit of being able to assess their performance at the MIRA test strip with its calibrated timing equipment – illustrated that there was no winner in the class, just contrasting approaches. Clearly the manufacturers had yet to work out what riders really wanted: each factory offered its own interpretation of what a 125mph 750cc sports machine should be.

I liked the Honda CB750F for all the same reasons that made the CB900F so appealing. The rider-bike interface was the best of the bunch, born of a long sleek fuel tank and a balanced but committed riding position resulting from a slightly raised but swept-back handlebar and rear-set footrests. The hand controls were light and smooth without any annoying roughness and grips, both hand and foot were soft rubber. The gearbox was precise and noiseless.

With a rev range from 1000rpm to the red line at 10,300rpm the CB750F's 79bhp engine was typically Honda: flexible and willing. Were it not for having the Suzuki and Kawasaki available for a direct comparison, you'd have thought that the Honda had a strong mid-range, but both the other bikes were more responsive, even though they pulled a higher top gear ratio than the Honda, which was revving busily at 5400rpm at 70mph. Only other flaw of the Honda was the level of high-frequency vibration that got through to the rider through the handlebar. Reflecting the Honda's lack of response was fuel consumption that ranged from 40 to 45mpg.

What slight deficiencies in the power delivery were made up for in the Honda's handling. It felt taut and agile, the suspension set up for roadholding rather than comfort with a level of feel from the Bridgestone tyres that was strangely better than on the Suzuki, even though the patterns were the same.

Unlike the CB900, the front fork didn't offer adjustable air pressure, though the rear shocks used both adjustability in rebound and compression damping, enabling riders to accommodate their own tastes in handling behaviour.

Braking from the triple discs, gripped by floating, single-piston calipers, was potent enough in the dry, but they squealed when wet. Honda had yet to get its brakes properly sorted.

> "WITH FOUR CYLINDERS ROARING BELOW, EVEN THE WEEDIEST NERD COULD SUMMON AN IMAGE OF RIPPLING MUSCLES, A DIET OF RAW BONES AND A QUEUE OF DRIBBLING PUBESCENT BABES."

RELAXED POWER

Once you got over the shock of the Suzuki's angular styling and its dubiously useful instruments such as a fuel gauge and digital gear indicator, it turned out to have the best engine of the three, being far punchier in the mid-range. With a light action to the twist grip and ergonomically well-thought-out handlebar levers, the power delivery from the shorter-stroke (67x53mm) engine felt both smooth and particularly lively from lower revs, which belied the higher claimed peak power of 80bhp at 9400rpm.

The relaxed power delivery made the Suzuki pleasant to ride over long distances, which were more easily achieved because it was more economical, with up to 51mpg, and had a larger 5.3-gallon fuel tank, giving a range of more than 250 miles.

Its handling was more suited to touring rather than sporty riding, with a long 60.2-inch wheelbase and soft suspension, despite the spring specifications having been stiffened up by the UK importers. The front fork, with a leading-axle design providing longer travel, suffered from lack of torsional rigidity and that also made the GSX750E slow to respond when pitching into corners. They often bottomed out during hard braking, but otherwise the slotted discs offered more than ample stopping power.

Compared to the Honda and especially the Suzuki, the Kawasaki was a little whippet of a machine. Smaller and lighter by about 50 pounds (almost

HONDA, KAWASAKI & SUZUKI 750CC FOURS, 1980-1983

Year	Honda	Kawasaki	Suzuki
1980	CB750FA launched 16-valve dohc four derived from CB900F 79bhp, 233kg dry	Z750E launched Dohc four derived from Z650 74bhp, 210kg dry	GSX750E launched Dohc TSCC four derived from GSX1100E 80bhp, 233.5kg dry
1981	CB750FA continued with revised detailing	Z750L introduced with bigger fuel tank	GSX750E continued
1982	CB750FA continued VF750S V-four shaft drive tourer launched	GPz750 launched with 80bhp and handlebar fairing. Z750GT shaft intro	GSX750EZ with round headlamp and centre-axle front fork, revised switchgear
1983	VF750F launched with V-four, chain drive, split fairing 90bhp	GPz750 redesigned with longer-chassis and 86bhp, frame-mounted fairing	GSX750ES launched with new oil/air-cooled 84bhp engine and chassis with 16in front wheel

> "CLEARLY THE MANUFACTURERS HAD YET TO WORK OUT WHAT RIDERS REALLY WANTED: EACH FACTORY OFFERED ITS OWN INTERPRETATION OF WHAT A 125MPH 750CC SPORTS MACHINE SHOULD BE."

a full tank load on the Suzuki), the Z750E was a logical development of the Z650. Inside the engine, valve sizes were bigger and the timing was longer than on the 650, and though power was lifted from a claimed 64bhp to 74bhp, less by far than the Honda or Suzuki, the Kawasaki could accelerate harder through the gears.

Silky power delivery with great throttle response and a rorty exhaust note made the bike great fun, especially because it was also nippier through the turns thanks to a wheelbase three inches shorter than the other bikes. Suspension had a wider range of adjustability with an air-pressurised front fork and four-position damping at the rear. Brakes too were great, with metallic pads in the calipers that were otherwise visually similar to the Honda's.

But if the Kawasaki held the performance and handling aces, its cramped riding position – partly a result of a much too lowered seat compared to the 650 and awkwardly positioned footrests – made it unsatisfying and annoying. Other frustrations included badly designed centre and sidestands, a vulnerable gear change linkage with lack of adjustability and a sloped seat that allowed the passenger to slide down onto the rider.

Because of their differing development backgrounds, the three bikes were completely different in character while remaining utterly conventional in their 1970s appearance.

It didn't stay that way for long. Increasing competition prompted a fresh look and within three years, Honda, Kawasaki and Suzuki had developed dramatically different machines in which chassis with more widely adjustable suspension, single-shock at the rear, smaller wheels with wider tyres, and fairings which housed more potent engines in new configurations were the norm.

SPECIFICATION

750CC FOURS 1980

MODEL	Honda CB750FA	Kawasaki Z750E	Suzuki GSX750E
ENGINE	Air-cooled inline four	Air-cooled inline four	Air-cooled inline four
CAPACITY	749cc (62 x 62mm)	738cc (66 x 54mm)	747cc (67 x 53mm)
VALVE OPERATION	DOHC 16-valve	DOHC 8-valve	DOHC 16-valve
COMPRESSION RATIO	9.0:1	9.0:1	9.5:1
LUBRICATION	Wet sump	Wet sump	Wet sump
IGNITION	Electronic inductive	Electronic inductive	Electronic inductive
CARBURATION	Four 30mm Keihin CV	Four 34mm Keihin CV	Four 32mm Mikuni CV
PEAK POWER, CLAIMED	79bhp at 9000rpm	74bhp at 9500rpm	80bhp at 9200rpm
PEAK TORQUE, CLAIMED	48ft-lb at 7500rpm	46.3ft-lb at 7500rpm	46.4ft-lb at 8400rpm
PRIMARY DRIVE	Hy-vo chain and gears	Morse chain and gears	Gears
PRIMARY RATIO	2.381:1	2.55:1 (27/23 x 63/29)	2.163:1 (93/43)
CLUTCH	Wet multiplate	Wet multiplate	Wet multiplate
GEARBOX	Five-speed	Five-speed	Five-speed
INTERNAL RATIOS	2.533, 1.789, 1.391, 1.160 & 0.964:1	2.33, 1.63, 1.27, 1.04 & 0.875:1	2.571, 1.833, 1.38, 1.125 & 0.961:1
FINAL DRIVE	530 o-ring chain	630 o-ring chain	630 o-ring chain
FINAL DRIVE RATIO	2.556:1 (46/18)	2.538:1 (33/13)	2.733:1 (41/15)
OVERALL RATIOS	15.4, 10.89, 8.47, 7.06 & 5.87:1	15.1, 10.56, 8.24, 6.73 & 5.66:1	15.2, 10.51, 8.16, 6.65 & 5.68:1
	12.9mph/1000rpm in top	13.4mph/1000rpm in top	13.3mph/1000rpm in top
FRAME	Tubular-steel duplex cradle	Duplex tubular steel cradle	Duplex steel tubular cradle
FRONT SUSPENSION	Telescopic fork	Telescopic fork, air assist	Telescopic leading-axle fork
REAR SUSPENSION	Swingarm, twin shocks	Swingarm, twin shocks	Swingarm, twin shocks
	5-pos spring preload, 3-pos reb	5-pos preload adj	5-pos spring preload adj
	2-pos comp damp adj	4-pos damping adj	
WHEEL, FRONT	Comstar light-alloy 19in	Cast light-alloy 19in	Cast light-alloy 19in
WHEEL, REAR	Comstar light-alloy 18in	Cast light-alloy 18in	Cast light-alloy 18in
TYRE, FRONT	Bridgestone 325H19 S703 tubeless	Dunlop 325H19 tubeless	Bridgestone 325H19 L303
TYRE, REAR	Bridgestone 400H18 S710 tubeless	Dunlop 400H18 tubeless	Bridgestone 400H18 S714
BRAKE, FRONT	Dual 275mm (10.8in) discs	Dual 260mm (10.25in) discs	Dual 275mm (10.8in) discs
BRAKE, REAR	295mm (11.6in) disc	260mm (10.25in) disc	275mm (10.8in) disc
ELECTRICAL SYSTEM	260w alternator, 60/55W headlamp,	238w alternator. 60/55W headlamp,	250w alternator, 60/55W headlamp
	starter motor, indicators	starter motor, indicators	starter motor, indicators
BATTERY	12v 14Ah	12v 12Ah	12v 14Ah
FUEL TANK	21 litres (4.4 gallons)	17.2 litres (3.8 gallons)	24 litres (5.3gallons)
WHEELBASE	1519mm (59.8in)	1420mm (55.9in)	1530mm (60.2in)
SEAT HEIGHT	825mm (32.5in)	800mm (31.5in)	825mm (32.5in)
CASTOR ANGLE	62.5 degrees	63.0 degrees	62.0 degrees
TRAIL	112mm (4.4in)	107mm (4.2in)	103mm (4.05in)
WEIGHT (DRY, CLAIMED)	233kg (512lb)	210kg (463lb)	233.5kg (514lb)
PERFORMANCE	44mph	45mph	46mph
SPEEDS IN GEARS	63mph	65mph	66mph
AT MAX POWER REVS	80mph	83mph	85mph
	97mph	101mph	105mph
	116mph	120mph	123mph
ESTIMATED TOP SPEED	125mph	122mph	128mph
ESTIMATED STR 1/4MILE	12.5s	12.3s	12.4s
AVE FUEL CONSUMPTION	42.5mpg	45.3mpg	44.3mpg
RRP INC VAT (1980)	£1780	£1729	£1699

Yamaha RD twins

When John Nutting tested the RD250 for Motor Cycle he liked it so much he bought it! Does RYN 50L still exist he wonders?

MOTORCYCLISTS who grew up in the Seventies and had more than hint of fire in their veins would have had to try a Yamaha two stroke twin. In whatever size they came - 125cc, 200cc, 250cc, 350cc or 400cc - they were fast and furious and could punch much more than their weight.

And their image wasn't the slightest bit tarnished by their close familial ties with Yamaha's production racers. Not for nothing were Yamaha's road twins appended by the prefix RD, meaning race developed.

The RD series replaced the 250cc YDS7 and 350cc YR5 and came with a much tidier engine layout using horizontally split cases, mainshaft mounted clutch and, for the first time, reed valve induction.

My own flirtation with them started after I'd tested the first reed valve RD250 to arrive in the UK for 'Motor Cycle'. It flew through the MIRA timing lights at a mean two-way top speed of 93.8mph back in the August of 1973, and its handling, confirmed by the 10mph faster RD350 I'd tested earlier in the month, was a treat.

When the RD250 had finished its demonstrator duties I bought it from the importers Mitsui Machinery Sales for what I recall was £500 and used it the following season for production racing at club level. (RYN 50L, where are you now?)

Nothing serious of course; all I did was fit a set of Dunlop TT100 tyres and rear-set footrests and convert the gearbox to enable the full six speeds to be used. (I can't remember why Yamaha blanked off the sixth ratio, but it was an

The RD400 John tested at MIRA in 1976 at 106mph.


The full line-up in 1976 from the 125 to the 400.

THE MIRA FILES...THE MIRA FILES...

Originally printed in the February 2001 issue of *Classic Motorcycle Mechanics*

easy fix and it clipped almost a half second from the standing quarter mile time - from 15.55 seconds with a terminal speed of 81.0mph to 15.15s at 85mph.

The bike would be ridden to the track (usually Brands) where registration plates would be replaced with number plates and the lights taped up.

The bike was reliable, fun and I've still got a couple of trophies to show for the experience. What innocence.

But while I've always been keen on Yamaha's twins, all the way through to the watercooled models, the earlier aircooled examples are my favourites.

At 'Motor Cycle' of course, I could indulge my enthusiasm and was able to taste every example that became available. For example, in the following January of 1973, Padgetts of Batley started offering race-style fairing, tank and seat kits along with footrests and provided a tweaked 250 for test.

The improved aerodynamics turned the bike into a genuine ton-plus 250 with a top speed of 100.29mph, despite a front wheel vibration that was unnerving. Not bad when a Ducati 750GT vee-twin I tested a few weeks later tripped the lights at just 109mph flat out.

YAMAHA didn't make any changes to the 250cc and 350cc twins until 1975 when they were offered with proper six-speed gearboxes. But the RD350B we tested in June of that year was in fact slightly slower than the original. Its mean top speed was just 102.6mph and the quarter mile time of 14.75 seconds at 88.5mph was 0.3 seconds down.

The following year, 1976, was when Yamaha introduced the first of what was to become the best of the series, the RD400C. This, like the 250, came with the 'coffin' styled fuel tank and an option of wire or cast-alloy wheels.

The larger capacity came from stroking the 350cc (64 x 54mm) engine to 398cc (64 x 62mm) and using 28mm carbs with revised jetting.

On paper, and especially the important MIRA test data, the 400 didn't appear to be much more potent than the 350cc model it replaced. In the May 1976 test, the mean top speed of OGT 370P was 103.29mph while the mean quarter mile performance was 14.8 seconds at 89.61mph.

On the road, the bike was a different matter, with enough poke from low revs to lift the front wheel under power without

THE MIRA FILES...THE MIRA FILES...

the slightest effort from the rider. It was dynamite, and brilliant fun to ride. In contrast, the RD250C tested the following month was slower than its predecessor at 90.52mph flat out and 15.95s through the quarter mile. Performance declined further with the RD250D tested in May 1977. This model, although slightly faster flat out at 91.8mph, could do no better than 16.4 seconds and 79.4mph through the quarter. In comparison my original model of four years earlier was a rocket.

Redemption was provided in 1978 when Yamaha introduced a number of changes with the RD400E. Both the engine and chassis were improved. The two stroke twin had CDI ignition, revised porting, longer inlet tracts and larger diameter exhaust pipes, the combined effects of which were to raise the claimed peak power to 44bhp at 8000rpm.

Handling was improved with larger diameter 35mm (up from 34mm) fork legs, lighter cast-alloy wheels, while cornering clearance was increased by the mounting of the footrests on plates above the exhaust pipes rather than on an assembly beneath them.

The potent one-piece brake calipers were replaced with floating single-piston units, not so much for more stopping power (which they couldn't offer) but for reliability, because the originals were prone to corrosion that was difficult to correct.

In July 1978, the RD400E zipped through the timing lights at MIRA to become the fastest-ever 400 at 106.64mph and blitzed through the standing quarter mile at 14.3 seconds with a terminal speed of 93.3mph.

None of the mid-range of the first 400 had been lost. It would rise to the occasion just by flicking the grip in the lower gears and was a smooth high-speed cruiser with its rubber-mounted engine keeping the vibes at bay.

This was mitigated by the fuel consumption that dropped to 30mpg at times (misers, of course, could have the four stroke XS400 twin). I liked the riding position but the rear suspension was hard and the brakes were too easy to lock up at low speeds, a legacy of the more spongy floating calipers.

This wasn't helped the following year in 1979 when the F models were introduced with revised graphics and longer, dog-leg levers. I have a painful memory of locking up the front wheel on a slippery Tottenham

THE MIRA FILES...THE MIRA FILES...

TEST REPORT

Yamaha RD400C. Reg no: OGT 370P. Date: May 4, 1976.

TEST CONDITIONS:	na.
AIR SPEED:	na.
AMBIENT TEMP:	na.
RIDER:	John Nutting.
RIDER WEIGHT:	168 lb.
CLOTHING:	one-piece leathers.
TOP SPEEDS PRONE:	East: 106.09/105.89 West: 100.49/100.15
MEAN OF BEST OPPOSED SPEEDS:	103.29mph
BEST ONE-WAY SPEED:	106.10mph
TOP SPEED, NORMALLY SEATED:	East: 93.39mph, West: 86.39mph
MEAN OF BEST OPPOSED SPEEDS:	89.89mph
ACCELERATION, STANDING QUARTER MILE:	East, 14.8s, 14.7s, 14.8s.
TERMINAL SPEEDS:	89.99mph, 90.90mph, 89.20mph
ACCELERATION, STANDING QUARTER MILE:	West, 14.9s, 14.9s, 14.9s.
TERMINAL SPEEDS:	87.75mph, 88.33mph, 88.15mph.
MEAN TIME @ TERMINAL:	14.8s @ 89.61mph

SPEEDOMETER ACCURACY:

IND MPH:	30	50	70
ACT MPH:	29.6	48.2	69.3

FUEL CONSUMPTION (FROM DISTANCE TRAVELLED ON HALF PINT OF FUEL):

CORRECTED SPEED (MPH):	30	50	70
DISTANCE (MILES):	5.2	4.2	2.6
MPG:	83.2	67.2	41.6

BRAKING DISTANCE (FROM CORRECTED 30MPH):	29ft 8in.
TURNING CIRCLE:	14ft 9in
TEST WEIGHT (INC ONE GAL OF FUEL):	343 lb

Yamaha RD400E. Reg no: n/a. Date: July 3 1978.

TEST CONDITIONS:	Windy, showery.
AIR SPEED:	three-quarter 20mph.
AMBIENT TEMP:	65 deg F.
RIDER:	John Nutting.
RIDER WEIGHT:	168 lb.
CLOTHING:	one-piece leathers
TOP SPEEDS PRONE:	East: 109.74mph, 109.50mph West: 103.54mph, 103.04mph
MEAN OF BEST OPPOSED SPEEDS:	106.64mph
BEST ONE-WAY SPEED:	109.74mph
TOP SPEED, NORMALLY SEATED:	East: 94.29mph, West: 84.13mph
MEAN OF BEST OPPOSED SPEEDS:	89.21mph
ACCELERATION, STANDING QUARTER MILE:	East: 14.3s, 14.0s, 14.0s
TERMINAL SPEEDS:	94.79mph, 96.04mph, 95.80mph
ACCELERATION, STANDING QUARTER MILE:	West: 14.7s, 14.6s, 14.7s
TERMINAL SPEEDS:	91.09mph, 90.54mph, 89.60mph
MEAN TIME @ TERMINAL:	14.3s @ 93.3mph

SPEEDOMETER ACCURACY:

IND MPH:	30	50	70
ACT MPH:	28.2	48.1	70.2

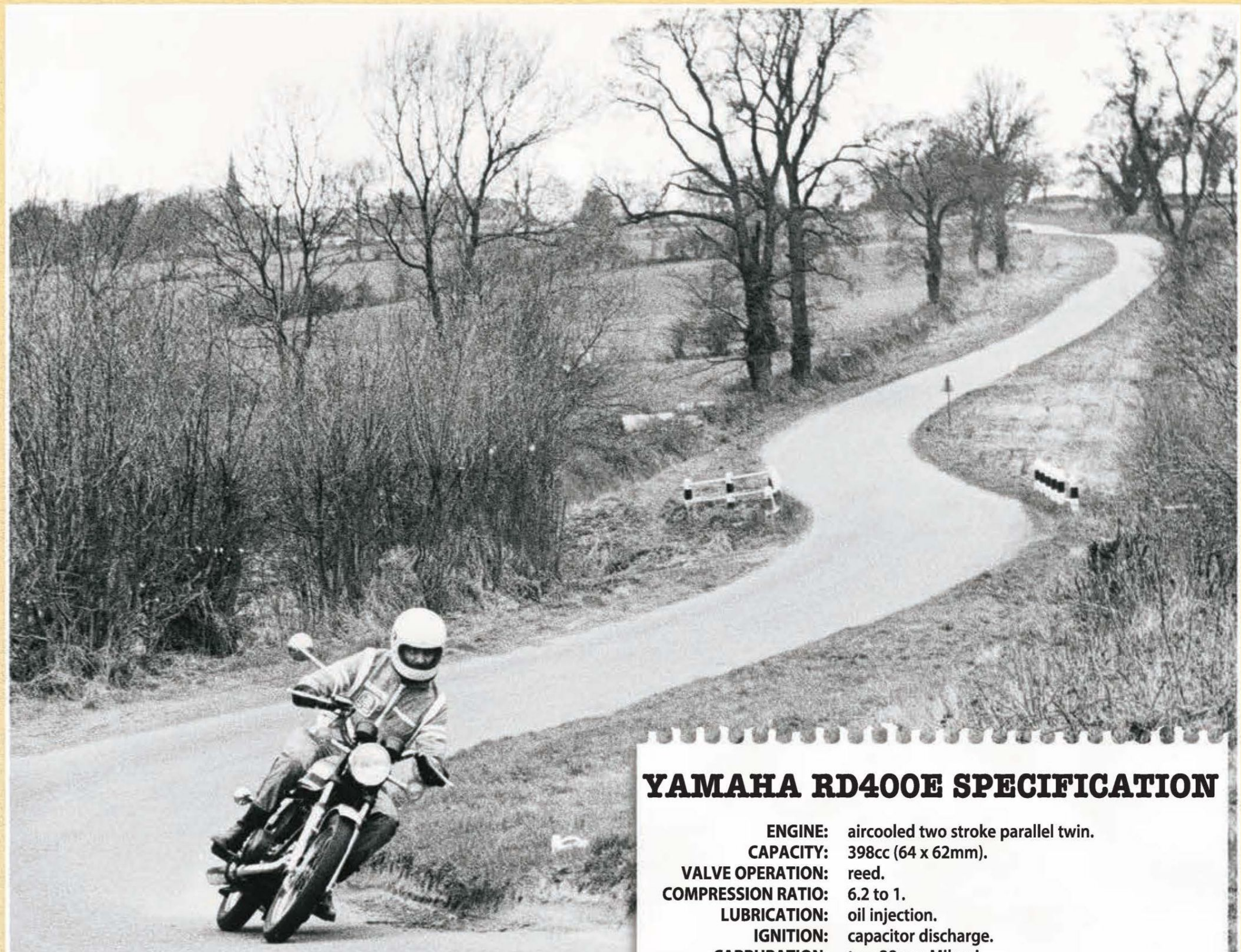
FUEL CONSUMPTION (FROM DISTANCE TRAVELLED ON HALF PINT OF FUEL):

CORRECTED SPEED (MPH):	30	50	70
DISTANCE (MILES):	4.5	4.1	2.4
MPG:	72.0	65.6	38.4

BRAKING DISTANCE (FROM CORRECTED 30MPH):	31ft 3in.
TURNING CIRCLE:	14ft 6in
TEST WEIGHT (INC ONE GAL OF FUEL):	343 lb

Gone but not forgotten - RD400s are a favourite for special builders today.

HE MIRA FILES...THE MIRA FILES...



John wasn't the only one to be impressed with the RD250 - former Classic Mechanics editor Bob Berry remembers with great fondness the bike he had on long term test at John's weekly rival bike paper MCN.

Court Road in London and unceremoniously dumping the bike down the road, fortunately without much damage.

With the new decade, Yamaha's aircooled twins were under siege in the US where exhaust emission regulations effectively outlawed two stroke road bikes. But the RD400G lived on in Europe in 1980 with cosmetic changes (no equivalent 250 was offered), soon to be replaced by the Europe-only watercooled RD250LC and RD350LC twins, opening up a new era in development.

For elegant simplicity, the aircooled twins were, and their survivors still are, a pinnacle of design that surpassed in performance and style anything the opposition could serve up.

YAMAHA RD400E SPECIFICATION

ENGINE:	aircooled two stroke parallel twin.
CAPACITY:	398cc (64 x 62mm).
VALVE OPERATION:	reed.
COMPRESSION RATIO:	6.2 to 1.
LUBRICATION:	oil injection.
IGNITION:	capacitor discharge.
CARBURATION:	two 28mm Mikuni.
PRIMARY DRIVE:	gear.
PRIMARY RATIO:	na.
CLUTCH:	wet multiplate.
GEARBOX:	six speed.
FINAL DRIVE:	520 chain.
FINAL DRIVE RATIO:	37/17.
OVERALL RATIOS:	16.5, 11.4, 8.46, 6.94, 6.13 and 5.7 to 1.
PEAK POWER:	44 bhp at 7000 rpm.
PEAK TORQUE:	na.
FRAME:	duplex tubular steel cradle type.
FRONT SUSPENSION:	telescopic fork, 35mm legs.
REAR SUSPENSION:	swingarm, twin shock, adjustable preload.
FRONT WHEEL:	cast alloy six spoke.
REAR WHEEL:	cast alloy six spoke.
FRONT TYRE:	Yokohama 90/90 H 18 tubeless.
REAR TYRE:	Yokohama 110/80 H 18 tubeless.
FRONT BRAKE:	single 270mm disc.
REAR BRAKE:	single 270mm disc.
ELECTRICAL SYSTEM:	alternator 190W, 35/35W headlamp.
BATTERY:	12V.
FUEL TANK:	na.
WHEELBASE:	52.25in (1325mm).
SEAT HEIGHT:	32in (810mm).
CASTOR ANGLE:	64 deg.
TRAIL:	96mm.
WEIGHT:	156kg (343 lb).

jurassicBIKE

Superbikes from the early eighties such as the Suzuki GSX1100 have been unfairly dubbed as unwieldy dinosaurs. John Nutting rode three of the earlier models, and thought they improved as they evolved

It's easy with hindsight to knock the super sportbikes of the early eighties like the Suzuki GSX1100 as being lumbering dinosaurs from the Jurassic period of motorcycling.

Potent but heavy, these monsters grew because there was nothing in their environment to stop them. They were top of the performance food chain.

And they had evolved unchecked from relatively nimble four-cylinder bikes of the previous decade as demand for power and speed outstripped the ability of the factories to find an alternative to the 'more is better' philosophy.

Eventually, as did with the more nimble and versatile mammals, a new order prevailed. In 1985 Suzuki launched its wieldy and ultra-light GSX-R750, a cut-down racer-styled road bike that could run rings around the bigger beasts.

But until then the Japanese factories had waged a power race without the aid of new-age technologies. Remember that commonplace modern features like aluminium-alloy frames, low-profile radial-ply tyres, liquid-cooling (for more compact engines) and more responsive brakes had yet to be developed for production bikes.

As each additional horsepower was wrung from the engines, so more pounds were added to beef up the tubular-steel chassis,

culminating in Suzuki's case with its final 1135cc four of 1984 boasting a peak power of 124bhp with a tanked-up weight close to 600lb.

But in the absence of lighter alternatives, these impressive beauties were the best we could hope for. And what a way to impress. Few could dispute that if you were in charge of machine with the potential to hit 60mph in four seconds, nudge 100mph in third and top out with 140mph on the clock, you were a rider of substance. Kawasaki's GPz1100, Honda's CB1100F and more rare CB1100R, Suzuki's GSX1100 and Yamaha's XS1100 were the range toppers, the two-wheel hot rods of the era. And among those who were able to ride them back-to-back and split their personalities, the Suzuki was arguably the most appealing of these muscle-bound machines.

My first contact with the GSX1100 was at a preview organised by the UK Suzuki importer in August 1979 when I was with Which Bike? Magazine; not to ride the bike but take a look. Having ridden the preceding GS750 and GS1000 models I was impressed by the revised suspension, featuring a leading-axle front fork with more adjustability and an aluminium-alloy swingarm. The bigger 1074cc 16-valve TSCC engine could only be better, but the styling was unimpressive.

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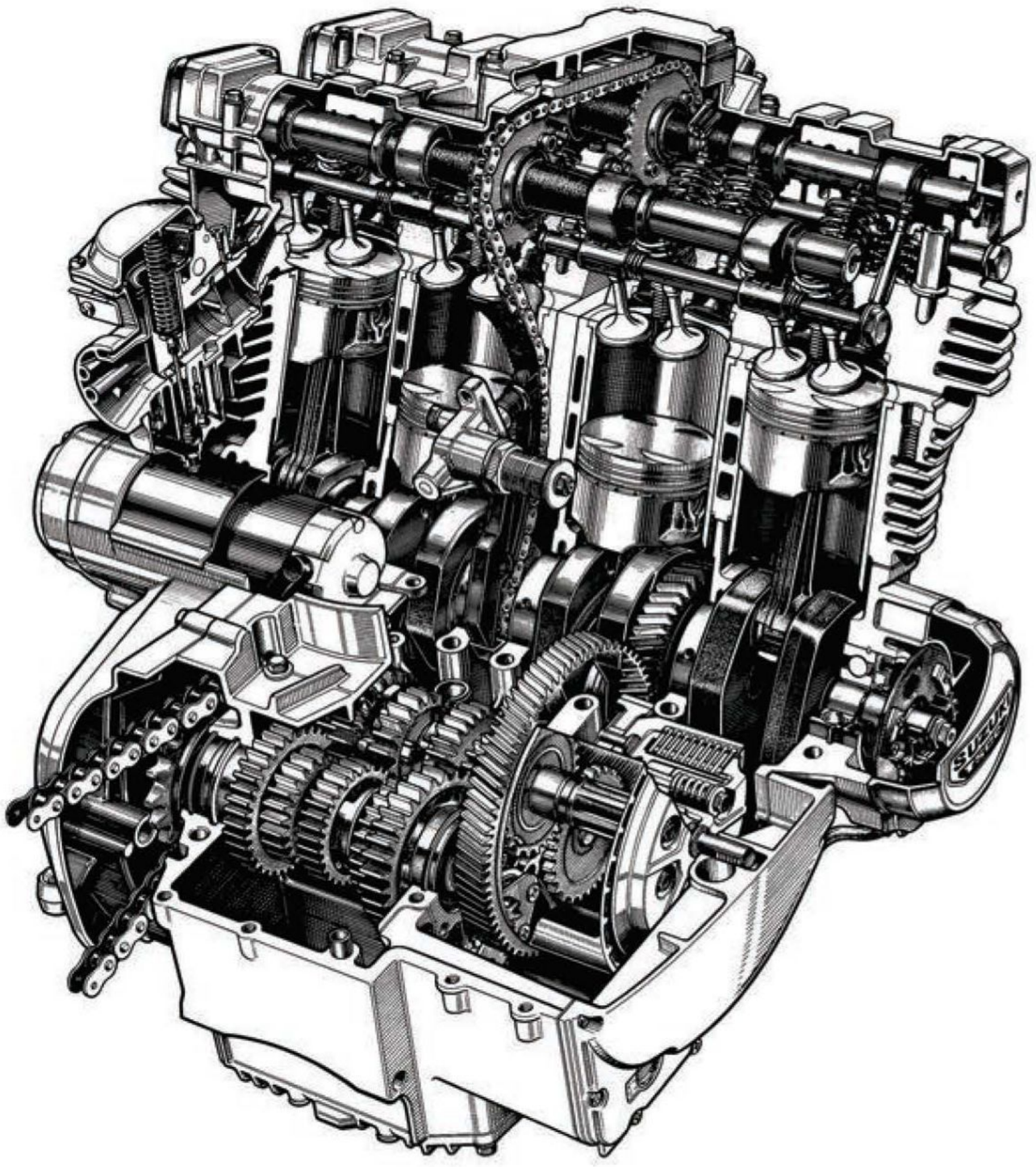
TECHNICALLY SPEAKING



For Suzuki, maintaining the power struggle as it entered the 1980s was much the same as its Japanese competitors: up the capacity of its range-leading GS1000 engine to 1100. But it also added a subtle technical twist that would provide a new acronym for the marketing people to play with: Twin-Swirl Combustion Chambers or TSCC.

The GS model's cylinder head was replaced with a design featuring four valves for each combustion chamber. Initial benefit was that the opening area for any given valve lift was larger than with two valves, enabling less radical valve timing and more flexibility. Also, because the combustion chamber could be designed with more squish area, it could be made more compact, enabling a higher compression ratio to be used that would improve the fuel burn rate.

Also these features had been exploited by Honda with its six-cylinder CBX and four-cylinder CB900F, launched in 1978, but Suzuki's TSCC offered, so it claimed, something extra. By machining the combustion chamber with a ridge between the pair of valves, and positioning the valves so that they slightly overlapped the cylinder bores, a measure of swirl could be imparted on the incoming mixture, improving the filling efficiency.

The bottom end of the GSX1100 four-cylinder engine used the same layout as the GS1000, but with the stroke of the pressed-up roller-bearing crankshaft increased from 64mm to 66mm, which with the cylinder bores increased from 70mm to 72mm, raised the swept volume to 1074cc.

Unchanged was the chain drive to the overhead camshafts with an automatic tensioner behind the cylinder block that was more reliable than other designs.

Breathing through a quartet of 34mm choke Mikuni CV carbs (more or less the same as on the GS1000), the GSX1100's peak power was lifted from the smaller engine's 90bhp to 100bhp at 8500rpm, with the torque curve peaking at 70.7 ft-lb at 6500rpm.

With Suzuki's familiar bottom-end layout of spur gears taking the power directly from the crankshaft to the multi-plate clutch and five-speed gearbox, the horizontally-split cases were as robust as they get, accepting power increases over the years from drag racers that were several orders of magnitude higher than originally anticipated.

To accommodate the more potent engine, the GSX1100 had a redesigned chassis with styling that broke the traditional Japanese mould. Although the tubular-steel frame was an uprated version of the GS1000 offering, the front fork used a leading-axle design that ostensibly offered more overlap between the bushes to provide smoother action. The 37mm-diameter stanchions also featured air-pressure assistance for the springs, adjusted from a single Schrader valve on the bottom yoke. Because the fork legs extended below the wheel spindle, their lower extremities allowed the fitting of adjusters for the rebound damping.

The rear suspension also featured tweaks that had been used in US production racing by tuners like Pops Yoshimura. The swing arm was a massive aluminium-alloy fabrication welded up from 35x 50mm extruded arms that were arguably stiffer than their steel counterparts. But they looked great. The twin shocks, with four-position damping adjustment just below their top mounts along with preload adjusters, were virtually straight off the GS1000.

Braking equipment was still in the dark ages with up front a pair of slotted discs gripped by floating calipers. Suzuki has also yet to break away from the then traditional wheel sizes of a 19in front matched to a 17in rear. The rear, switched from 18in two years earlier had been introduced to accommodate wider tyres for the new generation of more powerful machines that were now capable of reaching top speeds approaching 140mph.

> "THE BEST ONE-WAY SPEED WAS 142.5MPH, THE HIGHEST I'D EVER CLOCKED AT MIRA. THE ANTI-DIVE SYSTEM WORKED WELL, BUT THE BRAKES WERE ON THE LIMIT; BOTH 275MM DISCS WENT BLUE WITH THE HEAT."

The power was immense, wafting the machine to beyond the ton with absurd ease, but rough in delivery, mainly because of the roller-bearing crankshaft. Real urge started at 3500rpm (60mph in top) which coincided with a buzzy patch at just below 70mph in top gear making motorway rides a chore unless you were prepared to risk 80mph or more. And it was a risk because the rubber-mounted mirrors weren't much use when you needed them above 70mph.

But the suspension was much more sophisticated than on the GS1000. Supple and well-damped, the ride quality on the second of the four settings was luxurious but rough with the third. It was generally quite stable too, and only provoked a rear end wiggle when powering out of fast corners, which was surprising for a bike with a wheelbase as long as 60in (1510mm).

Without access to MIRA at the time, we didn't test the ultimate performance of that first model, but when two years later we tested the next model, the GSX1100EZ we were able to find out just how potent it really was.

For 1982, the GSX1100EZ was completely redesigned and despite an element of the Katana design cues was a more conventional-looking machine, but with its proportions balanced by a huge 200mm headlamp.

Suzuki had learned two things: that the original GSX1100 styling was a disaster and the Katana look was enduring enough to incorporate into its other models. It also tautened up the GSX1100's chassis with a lower front end featuring a centre-axle fork with anti-dive valve operated by brake actuation. As a result the front end was more firm and the steering slower but more appropriate for fast riding when stability at speed was preferable to comfort. This was helped by the longer stretch from the seat to handlebar, making high speeds on open roads easier on the legs than on the original model.

With the prospect of reaching top speeds in the region of 140mph on MIRA's test strip I was feeling a little uneasy. The last time I'd touched that speed was on a tuned Laverda Jota, and after passing through the timing lights at each end of the strip

TIMELINE GSX1100 YEAR BY YEAR

1979 August: Suzuki GSX1100ET launched with new 1074cc dohc 16-valve engine, leading-axle air-assist fork and light-alloy rear swingarm. 19in and 17in light-alloy wheels. 100bhp peak power. Angular styling accentuated by rectangular headlamp. Model called GS1100 in US.

1980 October: GSX1100EX the ET with minor detail changes to engine. Some models offered with black finished engine.

1983 GSX1100ED

1984 GSX1100EE

1981 September: GSX1100S Katana launched with Muth styling first seen in prototype form in 1980. Engine with 111bhp uses smaller 118mm alternator (standard is 130mm) and oil feed to starter motor removed to enable better crankshaft support. GSX1000S version with smaller bore 108bhp 998.6cc engine offered for production racing homologation.

1982 July: GSX1100EZ introduced with Katana-derived styling replaces angular EX model. Centre axle forks with anti-dive valving, larger round headlamp. Engine develops 111bhp.

1983: GSX1100ED gets black-finished engine and revised graphics along with new-style alloy wheels.

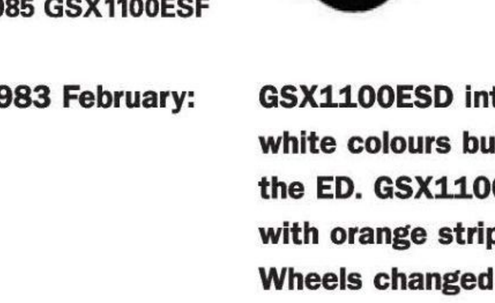
1985 GSX1100ESF

1986 GSX1100EFG

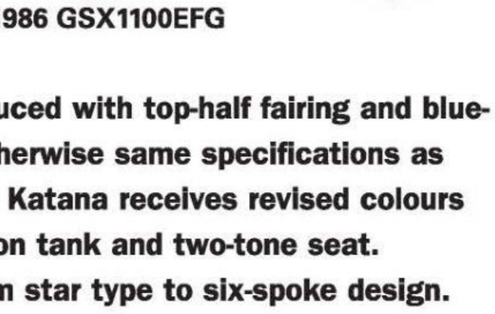
1983 February: GSX1100ESD introduced with top-half fairing and blue-white colours but otherwise same specifications as the ED. GSX1100SD Katana receives revised colours with orange stripes on tank and two-tone seat. Wheels changed from star type to six-spoke design.

1984 March: GSX1100ED discontinued and updated GSX1100EE introduced with 1135cc engine and peak power raised to 124bhp. Wheels changed to 16in front and 17in rear wheel. Revised frame with box section steel tubing. Equivalent ESE (with half fairing) and EFE (sports touring fairing) models include in range.

1985 July: GSX1100EF introduced with the same specification as GSX1100ESF and GSX1100EFF but without a fairing. GSX1100ES (GS1150ES in US market) reportedly discontinued in March 1985 in some markets, but available elsewhere until 1988.



1986 GSX1100EF



1987 GSX1100EF

1986 March: Naked GSX1100EG replaces GSX1100EF.

September 1986: GSX1100EFG sports tourer introduced in with the same specification as the GSX1100EFF but new red-white finish.

1987 February: GSX1100EF model discontinued. GSX1100SAE Katana reverts back to original silver paintwork.

1988 October: GSX1100E model discontinued.

1990: To celebrate Suzuki's 70 years since being founded, an anniversary GSX1100SL Katana is introduced with some detail changes to brakes and seat.

there was barely 200 yards before you reached the safety sand pit.

As with all bikes the first runs were taken sitting normally. But with a slight tail wind that meant the Suzuki was able to run up to 137mph easterly, so the ultimate test came earlier than expected. It hauled up with space to spare. And did so with repeated aplomb, despite the best one-way speed reaching 9000rpm in fifth at 142.5mph with a racing tuck, the highest I'd ever clocked at MIRA. When the mean top speed was worked out it was 136.19mph for the GSX1100, and 129.54mph sitting normally (well, as normal as you can get at that speed).

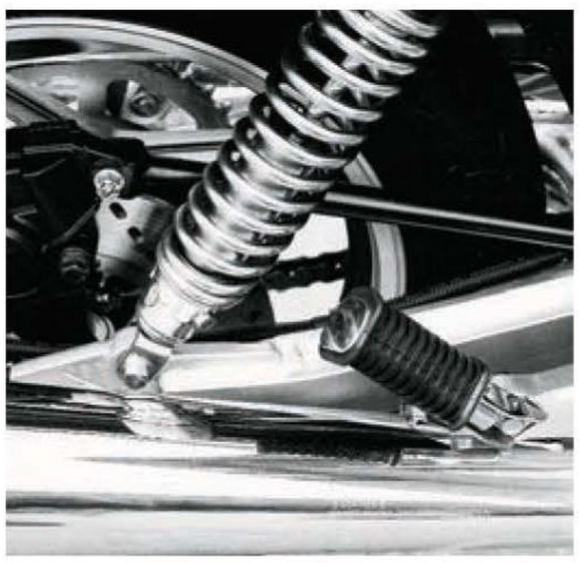
That top speed was about the same as Honda's 105bhp six-cylinder

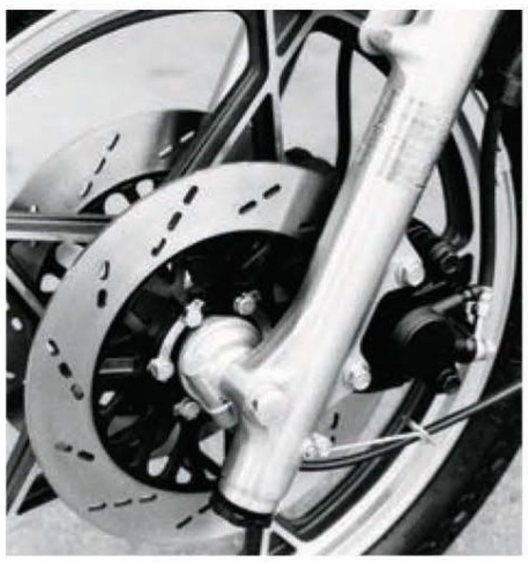
PERFORMANCE

All figures compiled at Motor Industry Research Association's proving ground, Nuneaton, Warwickshire.

Model:	Suzuki GSX1100E	Suzuki GSX1100ES
Date of test:	18 Aug 1982	8 Sept 1983
Reg No:	na	na
Mean top speed	136.19mph	136.37mph
Best one-way speed	142.40mph	139.80mph
Mean normally seated	129.54mph	131.39mph
Standing quarter-mile:		
(mean, sec/mph)	11.65sec/114.60mph	11.74sec/114.50mph
Speedo accuracy, actual mph at indicated:		
30	26.1	28.0
50	43.6	48.1
70	63.4	67.6
Overall fuel consumption (mpg)	42.0mpg	44.8mpg
Weight full tank	588lb	574lb

> SUZUKI HAD LEARNED TWO THINGS: THAT THE ORIGINAL GSX1100 STYLING WAS A DISASTER, AND THE KATANA LOOK WAS ENDURING ENOUGH TO INCORPORATE INTO ITS OTHER MODELS.





SPECIFICATION
SUZUKI GSX1100E (1980*; 1982**; 1984***)

POWER

ENGINE	Air-cooled in-line 16-valve four
CAPACITY	1075cc (72 x 66mm)*; 1135cc (74 x 66mm)***
VALVE OPERATION	Double overhead camshafts, chain-driven
COMPRESSION RATIO	9.5 to 1
LUBRICATION	Wet sump, 3.2litres
IGNITION	Electronically-triggered coils
CARBURATION	Four 34mm Mikuni CV, paper element filter
PEAK POWER	100bhp @ 8700rpm*; 111bhp @ 8500rpm**; 124bhp@ 8500rpm***
PEAK TORQUE	62.8ft-lb @ 6500 rpm*; 70.7 ft-lb @ 6500 rpm**; 77.2 ft-lb @ 6500 rpm***
PRIMARY DRIVE	Helical gears
PRIMARY RATIO	1.78 to 1 (87/49)
CLUTCH	Wet multiplate
GEARBOX	Five speed
INTERNAL RATIOS	2.50, 1.777, 1.380, 1.125 and 0.961 to 1
FINAL DRIVE	630 O-ring chain
FINAL DRIVE RATIO	2.80 to 1 (42/15)
OVERALL RATIOS	12.43, 8.83, 6.86, 5.59 and 4.77 to 1

CHASSIS

FRAME	Tubular steel duplex cradle
FRONT SUSPENSION	Light-alloy swingarm, twin shocks, 5-pos spring preload adj,
REAR SUSPENSION	4-pos rebound damping adj, 4.25in. wheel travel
FRONT WHEEL	Light-alloy, 19in; Light-alloy 16in***
REAR WHEEL	Light-alloy, 17in
FRONT TYRE	Bridgestone L303 350V19, IRC 350V19**; 120/70V16***
REAR TYRE	Bridgestone G506 450V17, IRC 450V17**; 140/80V17***
FRONT BRAKE	Dual 275mm discs, single-piston calipers
REAR BRAKE	Single 275mm disc, single-piston caliper
ELECTRICAL SYSYEM	Alternator, 60-55W H4 headlamp, starter motor
BATTERY	12v 14Ah

DIMENSIONS

FUEL TANK	22.5 litres (4.9gal), 21.5 litres (4.8gal)**
WHEELBASE	1510mm (59.4in)*; 1550mm (61.0in)***
SEAT HEIGHT	805mm (31.7in)
CASTOR ANGLE	62-deg
TRAIL	103mm (4.05in), 116mm (4.57in)**
WEIGHT (CLAIMED)	243kg (536lb), 239kg (527lb)**

CBX, tested four years earlier in 1978. And as it turned out the acceleration from a standing start was about the same as well, with five runs through the quarter mile, the best two of which in opposite directions were 11.49 seconds with a terminal speed of 117.90mph and 11.82s/111.34mph for an average of 11.65s at 114.60mph, not bad for a bike that weighed in at 588lb tanked up.

Despite this potential, the bike was reasonably civilised in day-to-day use. The clutch was light and smooth in its take-up of the drive and the gearbox crisp though slightly clunky sometimes at lower engine revs as the engine strained at the leash. Its flexibility paid off with, for such a big bike, miserly fuel consumption that averaged 42mpg overall and up to 200 miles to a tankful if you were careful on the twistgrip.

Just over a year later we took 1983 models to MIRA, including the GSX1100ES, now with a small frame-mounted fairing that I thought would lift the top speed into the dangerous territory at MIRA where you could reach the sand pit at the end of the strip.

If anything, the GSX1100ES had become even more civilised, even though its engine specs were much the same as the previous year's models. Strangely too, despite the addition of the fairing, the bike was, at 574lb, some 14 lighter than the 82 machine.

In fact, the mean top speed was more or less identical with the two opposed speeds of 139.80mph and 132.94mph producing an average of 136.37mph. It's likely that the 83 model was less potent then the 82 one, but then the top speed sitting up was higher at 131.39mph at 8000rpm, which is what you'd expect.

A clue to the reduced peak power theory was provided by a slower quarter mile time of 11.74 seconds, but the terminal speed – which is the best measure – was virtually unchanged at 114.5mph.

The engine was more flexible though, and this was also borne out by lower fuel consumption: an average of 44.8mpg. One brief trip even returned 56mpg.

The next incarnation of the GSX1100 was the following year's 1135cc version with a heady 124bhp. It also sported almost gothic styling and a fashionable 16in front wheel that did nothing for the handling.

The GSX1100 was relegated to the sports touring category with a more enveloping fairing, but by 1988 had been de-listed from the range as more agile machines reached the market. The swansong of the 1100 was the Katana produced in 1990 to celebrate Suzuki's 70th anniversary. Versions for the Japanese market continued to be made into the 21st century, but the age of the dinosaurs had finished more than a decade earlier.

XT500 AND SR500 YAMAHA SINGLES

The pleasures of a Big Single

Yamaha's XT500 and SR500 four stroke singles of the Seventies proved that the Japanese factories had engineers with classic dreams. John Nutting tested both bikes at MIRA's proving ground.

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classic motorcycle mechanics

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After the success of the XT500 trail bike Yamaha saw the potential for a road version and the SR500 was born to live on for 20 years.

THE Summer of 1976 was hot, really hot. Not the kind of weather to start getting used to big four stroke singles again. But that was the year Yamaha launched its XT500 enduro-style plonker.

It was the first time that a Japanese factory had produced a four stroke bigger than 250cc using a modern design. Up-to-date, the XT500 came with all the goodies that road bike fans in the Fifties could only have dreamed about.

With chain-driven overhead camshaft and unit construction but with a traditional vertical split crankcase, it was exotic but sanitary. It even had clever features to make anyone look tough when firing it up with the kick-starter. The XT500 was so neat that Yamaha two years later came up with the SR500 version for road use that built up such a following that they were still being made more than two decades later.

So although the nights were steaming in 1976, XT500 riders could bask in the glory of big singledom with barely a bead of sweat. Indeed, they were more likely to get worked up slogging the bike down green lanes. Everyone seemed to love the XT500, especially dirt-bike riders eager for something less frantic than the two strokes they'd been used to.

Yamaha's 500cc single arrived at a time when the Japanese factories were revolutionising their ranges. Suzuki was polishing off the development of its new four stroke 750cc four. Honda, having completed its first proper car range, was making its bikes more sporty. Kawasaki launched its first 650cc four. And Yamaha was about to reveal its first 750cc triple. Even cynics would concede that bikers had never had it better.

Whoever it was that designed Yamaha's single knew what made riders tick. They also knew that the key to the engine's appeal was smooth power delivery and immediate throttle response.

To achieve the first objective it was necessary to use a traditional pressed-up crankshaft with full-circle flywheels that damped out the power pulses but not to use such a heavy crank that it would cut acceleration.

To get better response at the twistgrip, the engine's architecture used slightly oversquare bore and stroke dimensions of 87 x 84mm, providing a 7000 rpm red line with good mid-range punch.

Up top, the cylinder head used a 47mm (1.85in) inlet valve and a 39mm (1.55in) exhaust with modest timing provided by the single overhead chain-driven camshaft. Compression ratio was 9:1, more than most big singles had been in the past but low enough to run on unleaded fuel.

Both crank and camshaft ran in roller and ball bearings, with gear drive to the multiplate clutch and five-speed gearbox. Lubrication was with two Eaton-style pumps for feed and scavenge because the engine had a dry sump, the six pints of oil being carried in the bike's frame and filtered by a cassette mounted in the primary drive cover.

As with most trail bikes of the time, the electrical system was rudimentary, with a crankshaft-mounted flywheel magneto providing the sparks. Also inside the magneto were alternator coils that fed the six-volt headlamp direct, other coils charging the small battery for the direction indicators, horn and stop lamp. The idea was than the owner could remove the electrics quickly. Indeed, the TT500 version of the bike primarily aimed at the US market was supplied thus.

But while the XT500 sounded just as a lusty single should and pulled like a train, it appealed just as much because you could start it! These days most big singles come with an electric starter but 30 years ago no-one had been able to design a drive that was reliable enough. And the weight would have been out of the question.

What did make the XT500 more refined than the singles of yore was kick-starter drive gears that connected to the crankshaft

SINGLE SERIAL NUMBERS

Yamaha 500cc 1976-1981, US market
(from the SR500 page
www.~siue.edu/~rsutton/SR/sercolor.htm)

YEAR	MODEL	US
1976	XT500C	1E6-000101
	TT500C	583-000101
1977	XT500D	1E6-100101
	TT500D	1T1-000101
1978	XT500E	1E6-000101
	TT500E	1T1-100101
	SR500E	2J2-000101
1979	XT500F	1E6-220101
	TT500F	1T1-200101
	SR500F	2J2-020101
1980	XT500G	3H6-000101
	TT500G	1T1-230101
	SR500G	3H1-000101
1981	XT500H	4R9-000101
	TT500H	2Y0-000101
	SR500H	4R8-000101

through the clutch basket, enabling the engine to be spun over in any gear provided the clutch was disengaged.

A Mikuni VM34SS carburettor had fine metering control and push-pull cables, and an exhaust-valve lifter that made it easier to turn the engine over compression so that it could be positioned at the beginning of the exhaust stroke.

A deliberate swing on the kick start lever always produced the results, and because it disengaged at the bottom of the swing, there was no fear that it might re-engage if it bounced back from top-dead-centre and give your instep a jolt.

Out on the road, the XT500 provided a platform for riders to fantasise that they were real dirt riders but on a machine that could handle reasonably well and cruise economically. Detailing offered all the right features, from the 2.2 gallon alloy tank, booted controls, supple suspension and crisp transmission.

Real dirt riders found it acceptable on moto-cross tracks even though the rear shocks were soft. Although I tested the bike for *Motor Cycle*, my dirt riding experience was limited so we called on schoolboy moto-cross champion Paul Hunt (where are you now, Paul?) for his opinion. He fell for the big lazy engine and soon got used to the soggy suspension but found the precision of the front fork surprisingly good.

Treated as a road bike, the XT500 was great fun. It could cruise at 70-75 mph and although there was some vibration, the worst of which was at 5000 rpm (about 65 mph) it wasn't bad enough to be painful. For commuting it was ideal, the flexibility of the engine providing a relaxing ride along with remarkable economy, returning 73 mpg.

GOOD SPEED

OUT of curiosity, I took the XT500 to MIRA to find out just what it could do. Top speed with a normal riding position was 80.7 mph. Not bad with a moto-cross handlebar, but ducking down behind the clocks pushed the flat out mean to 89.2 mph at 6500 rpm, showing it was geared just about right.

Claimed peak power was 30 bhp at 6000 rpm and with a wet weight of 294 pounds to propel, it would have been no surprise that the XT500's acceleration was about the same as a sports 250cc twin. And so it was, with a mean quarter mile time of 16.0 seconds and a terminal speed of 80.6 mph.

For road use, the XT500's obvious shortcomings were the combination of trail tyres and drum brakes. Sure, you could corner until the fold-up pegs were scraping but it was a mind-altering experience getting there. And the best stopping distance from 30 mph I could manage at the test strip was just over 32 feet, well below the usual of about 28 feet.

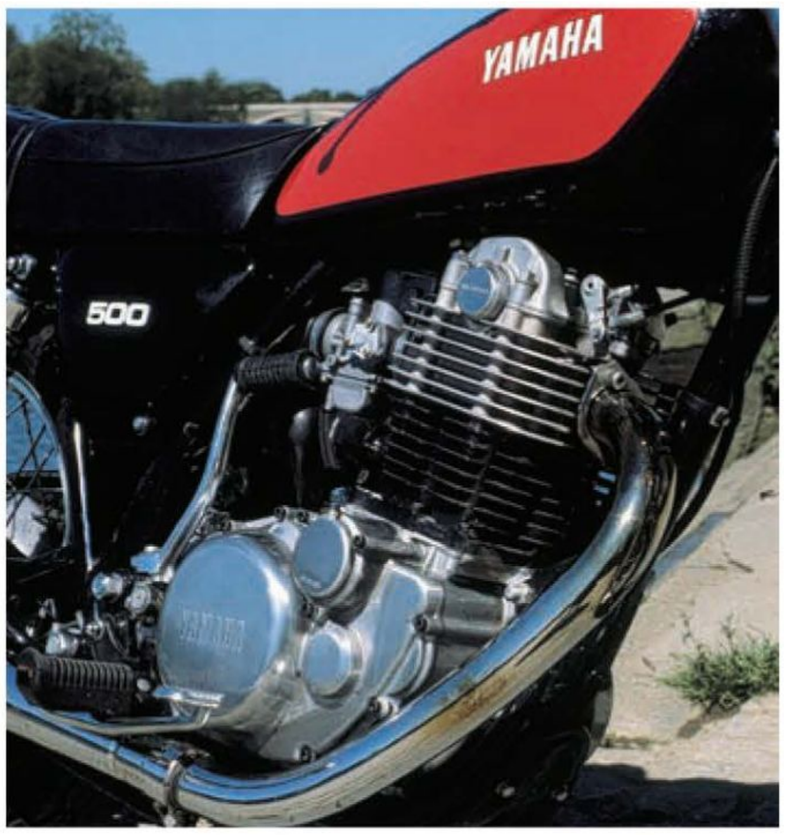
Yamaha developed the XT500 further with more sophisticated suspension including a leading-axle front fork but was sidelined. It was replaced in 1982 by the XT550 which featured a four-valve aircooled engine and a monoshock chassis. This evolved into the XT600 and the liquid-cooled XT660 introduced in the 1990s.

Road riders however saw the first XT500's engine as an ideal candidate for powering a modern lightweight single. Yamaha's engineers did as well, and early in 1978 the factory revealed its SR500 at the same time as the XS1100.

Launched to the press in company with the huge shaft-drive four in West Africa, the SR500 was viewed as an amusing but incongruous aberration. Given a crystal ball, the press would have been amazed to find that the bike would still be in production more than a quarter of a century later.

What the singles fans at Yamaha had realised was that having fun on a road bike isn't all about daunting power and overwhelming technological clout. All you need on many roads, and especially the twisty ones, is a light machine with good handling and lively throttle response.

And the SR500 did just that. Designed unpretentiously, it harked back to the times when each component had its place. There were no frills but everything fitted perfectly



Valve timing was changed to raise power for the single cylinder road bike.

YAMAHA XT500C

ENGINE

Air cooled single
Capacity 499cc
Bore and stroke 87 x 84mm
Valve operation overhead camshaft
Compression ratio 9:1
Lubrication dry sump 6pt
Ignition flywheel magneto
Carburation 32mm Mikuni VM
Peak power 30bhp at 6,000rpm
Peak torque 28lb-ft at 5,400rpm

TRANSMISSION

Primary drive gear
Primary ratio 77/30
Clutch wet multiplate
Gearbox five speed
Internal ratios 2.357, 1.555, 1.190, 0.916 & 0.777 to 1
Final drive 530 chain
Final drive ratio 44/15
Overall ratios 16.6, 11.0, 8.4, 6.46 and 5.48 to 1

CHASSIS

Semi-duplex steel cradle incorporating oil tank

SUSPENSION

Telescopic front fork (7.7in travel)
Pivoted rear fork (4.4in travel) with twin De Carbon spring-damper units

WHEELS

Laced spoke, light-alloy rim front
Laced spoke, light-alloy rim rear

TYRES

Bridgestone 3.00 x 21 front
Bridgestone 4.00 x 18 rear

BRAKES

6.3in drum front
5.9in drum rear

ELECTRICS

6-volt alternator, direct lighting, 5in headlamp,

WEIGHTS AND MEASURES

Battery 6V-6AH
Fuel tank 10.3litres (2.2gal)
Wheelbase 1,420mm (56in)
Seat height 825mm (32.5in)
Castor angle na
Trail n/a
Weight 294lb with a gallon of fuel

The engine was traditionally styled with vertically-split crankcase.

SINGLES PERFORMANCE COMPARISONS

YEAR	MODEL	MEAN TOP SPEED	ST 1/4 MILE MPH SECS/MPH
1976	Yamaha XT500 ohc single	89.19	16.00/80.6
1978	Yamaha SR500 ohc single	97.07	15.50/83.7
1978	Honda CX500 ohv v-twin	110.4	14.50/92.5
1976	Yamaha XS500 dohc twin	107.7	15.00/89.0
1978	Suzuki GT250X7 ts twom	94.40	16.05/80.6
1973	Yamaha RD250 ts twin	93.80	15.55/81.0
1976	Suzuki GT250 ts twin	92.10	16.05/80.0
1977	Kawasaki KH250B2 ts triple	92.05	16.30/79.5

YAMAHA SR500E

ENGINE

Air cooled single
Capacity 499cc
Bore and stroke 87 x 84mm
Valve operation overhead camshaft
Compression ratio 9:1
Lubrication dry sump, 6 pt
Ignition capacitor discharge
Carburation 34mm Mikuni VM
Peak power 33bhp at 6,500rpm
Peak torque 28.2 lb-ft at 5,500rpm

TRANSMISSION

Primary drive gear
Primary ratio 77.30
Clutch wet multiple
Gearbox five speed
Internal ratios 2.357, 1,555, 1.190, 0.916 & 0.777 to 1
Final drive 530 chain
Final drive ratio 44/16
Overall ratios 15.86, 10.48, 8.02, 6.17 and 5.24 to 1

CHASSIS

Semi-duplex steel cradle incorporating oil tank

SUSPENSION

Telescopic front fork
Pivoted rear fork, with twin spring-damper units

WHEELS

Laced spoke, light-alloy rim front
Laced spoke, light-alloy rim rear

TYRES

Yokohama, 3.50 x 19 front
Yokohama, 4.00 x 18 rear

BRAKES

11.5in disc front
6.5in drum rear

ELECTRICS

Alternator, 60/55W 7in sealed beam headlamp

WEIGHTS & MEASURES

Battery 12V-7AH
Fuel tank 10.3litres (2.2 gal)
Wheelbase 1,415mm (55.75in)
Seat height 805mm (31.75in)
Castor angle 62.5deg
Trail 116mm (4.6in)
Weight 353lb with a gallon of fuel

and provided just the right level of specification that would appeal to the rider looking either for a simple runabout or the basis of cafe racer.

Style was measured by the light-alloy rims, the large-diameter headlamp, twin shocks and the classic sweep of the exhaust pipe and silencer.

Those looking for a sanitized single with more handling precision than the XT500 trail bike were more than satisfied. When I collected the test bike in June 1978 1 couldn't believe that a 500cc four stroke single could be so civilized, yet feel just as a classic single should: taut as it launched out of bends with none of the frantic buzziness of the fours and twins of the era. I hadn't had as much fun on a bike in ages.

To raise power, valve timing was changed to lift the torque higher in the rev range. Though the increase was modest, to a peak torque figure of 28.2 lb-ft at 5500 rpm, peak power jumped to 33 bhp at 6500 rpm. Apart from extra finning on the cylinder head, the engine was mechanically unchanged though the 34mm Mikuni carburetor came with an accelerator pump to enable leaner metering without spoiling throttle response.

Kick starting was aided by an indicator on the end of the camshaft that could be viewed through a tiny window in the cover. When the white mark could be seen, you were ready to swing. Electrically, the SR500's system was completely revamped with capacitor discharge ignition and a 12-volt battery to power the seven-inch headlamp's sealed unit.

Although intended for the road, the bike's styling took a cue from Yamaha's US flat track activity. It used Bridgestone Mag Mopus tyres - 350x19 and 400x18 - that were fat with block treads while the handlebar had a wide sweep. In day-to-day use you'd probably never notice because the riding position, with plenty of room provided by the tucked-in footrests, was so good.

But the temptation to push the bike to the limits of the rubber's grip was too great and you could find them very quickly. I wondered how more sporty tyres might affect the road holding so I fitted a pair of matched Continentals, a ribbed 325x19 front and a 400x18 rear, and changed the cowhorn handlebar for a narrower version from an XS750 triple.

The transformation was dramatic, improving handling precision and grip, lightening the steering and tightening up the riding position.

The bike was much more fun on twisty roads and even turned out to be a pretty good cruiser.

The SR500's styling took a cue from the American flat-trackers of the day.

Yamaha's big XT500 thumper made an excellent road bike and also performed well on England's green lanes.

Kick starting an XT was easy once you got the knack

Vibration from the engine was minimal, the worse being at around 4000 rpm, but as I said when I tested the bike, "It's a nicely rounded type of buzz that, thanks to the rubber-mounted footrests and handlebar, never bites into your fingers or toes." To put the Yamaha into perspective though, the Kawasaki 650 custom I tested at MIRA on the same day felt like pure luxury.

With overall gearing raised by use of a 16-tooth gearbox sprocket rather than the XT500's 15-tooth item, the SR500 offered a theoretical 103 mph at 7000 rpm in top gear. But with me flat on the tank in racing leathers it couldn't quite pull it, the motor peaking at 6500 on the timing straight, a mean two-way top speed of 97. 1 mph. On the slightly downhill run it clocked a best of 99.2 mph.

Acceleration was much better than the XT500's despite the SR500 weighing 20 per cent more at 353 pounds with the 2.2 gallon tank half full. It raced through the quarter mile in 15.5 seconds with a terminal speed of 83.7 mph, about the same as my RD250 two stroke twin with six speeds.

And the generous 11.5-in disc front brake with its floating caliper was more than up to the job, giving a stopping distance from 30 mph of 29 feet.

All the more remarkable was the fuel consumption. Commuting across south London it clocked 78 mpg while cruising on the motorway this dropped to 70 mpg. During the performance testing at MIRA it dropped further but only to 60 mpg. So even if you thrashed the bike it would still have a range of 120 miles.

The combination of a 100 mph top speed with fuel consumption of 70 mpg had long been an objective of many enthusiasts which had almost been achieved in the SR500.

In contrast, Yamaha's complex dohc XS500 parallel twin had a top speed of almost 108 mph but could only manage 48.5 mpg. And Honda's clever CX500 vee-twin with 50 bhp on tap could top 110 mph but consumption was even heavier at 45 mpg.

It's no wonder that the SR500 developed a strong following over the years and that fans of the bike turn it into all manner of confections with capacities up to 650cc and tuning options that boost power beyond 50 bhp. The Japanese market 400cc version remained in production into the 21st century and the 500cc engine is supplied to BSA-Regal for its limited production Gold SR sports bike.

Few machines have such an enduring appeal. In a world full of wild 150 bhp plus rockets, the SR500 harks back to a period when fun was measured in more subtle ways.

The XT500 clocked just under 90 mph at MIRA.

PERFORMANCE DATA

All figures compiled at Motor Industry Research Association's proving ground, Nuneaton, Warwickshire.

	Yamaha XT500C	Yamaha SR500
DATE OF TEST	17 July 1976	31 May 1978
REG NO	RGC 648P	CGK 28S
CONDITIONS	n/a	Fine, 75degF 15mph wind
MEAN TOP SPEED (MPH)	89.19	97.07
BEST ONE-WAY (MPH)	94.05	99.24
MEAN NORMALLY SEATED (MPH)	80.71	81.03
STANDING QUARTER-MILE (MEAN, SECS/MPH)	16.0/80.62	15.5/83.7
ACCELERATION (SECS/MPH)		
110yards	6.0/52.7	6.0/54.3
220yards	9.9/68.6	9.6/69.2
330yards	12.6/75.1	12.6/77.7
CONSTANT SPEED MPG @ MPH		
30	100	102
50	67	86
70	50	64
OVERALL FUEL CONSUMPTION	60.5 mpg	69.9 mpg
BRAKING DISTANCE (FROM 30MPH)	32.1ft	29ft
TURNING CIRCLE (FT)	4m	14.75ft
SPEEDO ACCURACY, ACTUAL MPH AT INDICATED		
30	29.3	29.4
50	49.2	47.8
70	71.6	68.4
TEST WEIGHT (1 GAL FUEL)	294 lb	353 lb

Cut off in its PRIME

Suzuki's GT750 two stroke triple might have gone on a greater success had it not been upstaged by four stroke development. John Nutting has ridden both the early and late versions of this iconic Japanese machine.

Originally printed in the November 2002 issue of *Classic Motorcycle Mechanics*

THE development of electronics wasn't fast enough to stop the road-going two stroke engine being outlawed in the Eighties. Had they been, we might now be riding sophisticated descendants of the Suzuki GT750 developing more than 150 bhp, using clever fuel-injection systems and lubrication operated by high-power computers.

As it is, the automotive industry had no option in the face of tightening exhaust emission laws during the Eighties than to take the easier option of phasing out two strokes for road bikes in favour of four strokes.

For many fans of the two stroke, with its inherent simplicity and flexibility of application for both road and sport, it was a dark day when production of high performance road bikes ended in the late Eighties. Two strokes live on of course in scooters, and many incorporate engine control systems, but the chance of a big two stroke machine returning is remote.

Suzuki, like Yamaha, had built its reputation on sizzling two strokes evolved through the Sixties. Its biggest coup was when it tempted racer Ernst Degner to defect from the East German MZ factory and join them - with the secrets of Walter Kaaden, its fabled engineer, who had raised the performance of its disc-valve two strokes way beyond anything the Japanese had been capable of.

With a fist full of world road racing championships won during a period of increasing consumer wealth, Suzuki offered bigger and better bikes. This followed its two stroke twin theme culminating with the T500 Titan in 1968. Like Yamaha, Suzuki was cautious in offering a 750 to follow Honda and Triumph's lead that same year. But when eventually it did, riders were stunned.

The 750cc three was revealed at the 17th Tokyo Motor Show in October 1970. With liquid cooling, four exhaust pipes, a 150 mph speedo and a 7000 rpm red line, the bike was a bombshell. Few details were available, but reports speculated that it could produce in excess of 70 bhp, offering a top speed of more than 120 mph.

Having whetted riders' appetites, Suzuki kept the bike under wraps and continued development of what was originally called the T750R. This is according to The Kettle Club, the owners' club formed in 1995 to support the continuing use of the two stroke triple.

The first GT750s appeared on the US west coast at the end of 1971 but first hopes of a two stroke rocketship like Kawasaki's Mach III would be dashed. It was a heavyweight luxury Grand Tourer - as its title suggested - with smooth flexibility and modest top speed in the region of 110 mph.

GT750M tested by John Nutting at MIRA in 1975 at a mean top speed of just under 120 mph.

Lost in time

JUST why the GT750 turned out to be so gentlemanly is probably lost in the mists of time. Unlike today when project chiefs for superbikes are as much heroes as the racers who win on them, access to the designers was impossible. Indeed, few, if any, journalists before 1976 went to Japan to quiz the engineers.

Whoever it was, they did their best with a huge challenge of squeezing three cylinders across the bike, hanging a generator, electric-start drive and ignition system on either end and still making it only slightly wider than a CB750 Honda.

The water jacket - a first on a two stroke roadster from Japan - helped, along with twisting of the transfer and exhaust port axes to save space. Tuning was softer than the T500 though it used the same 70 x 64mm (giving 738.9cc) bore and stroke dimensions.

With 32mm VM Mikuni carburettors and a 6.7 to 1 compression ratio, the engine developed a claimed peak power of 67 bhp at 6500 rpm with maximum torque of 55.7 lb-ft at 5500 rpm. Although the prototypes boasted electronic sparks, coil ignition with three contact breakers were used on the production models.

As with most two strokes, the crankshaft was built up with ball main bearings and roller big ends lubricated by a pump whose output was controlled by engine speed and throttle opening.

Power was delivered by gears between cylinders one and two (from the right) to a five-speed all-indirect gearbox and

Words/Pictures: John Nutting

drive chain. Top gear gave 110 mph. The design plot was lost with the chassis. A conventional duplex steel tube frame held everything together but up front a double-sided twin leading shoe drum provided the braking.

Styling matched the bulk of the exhaust system in which the silencers for the two outer cylinders were complemented for the sake of symmetry with a bifurcated middle system. Ahead of the cylinders, a radiator with a cooling fan maintained the temperature at about 80 deg C.

Styling was straight out of Thunderbirds, with swoopy lines for looks rather than function - and vivid turquoise paint. Riders were impressed with the engine's smoothness, quietness and flexibility, admiring the way in which it would pull strongly from as 1500 rpm while offering relaxed cruising at above 80 mph.

But there was a sting in the Suzuki's tail. Suspension that was inadequate for the GT750's tanked-up weight of 560 pounds, limited cornering clearance, poor braking and Bridgestone tyres that were frightening in the wet added up to a bike that called for respect when the road surface was suspect. Having joined the staff of *Motor Cycle* in April 1972 I was unlucky to have just missed testing the first version available on the UK market, the GT750J.

Still a bit wet behind the ears, I thought the Suzuki looked fantastic, and the idea that a Japanese factory would offer a high-performance motorcycle with such inadequacies seemed impossible. I soon found out the truth.

The GT750A of 1978. The best selling model says the Kettle Club.

Safe distance

NEARLY two decades later, my rose-tinted goggles were cleared. For a magazine feature about the GT750 I rode a model restored by Lee Chambers, who at the time was

The M model was the first Suzuki triple our man had ridden. "Turbine-like power from the rubber-mounted engine, smooth controls and a relaxed riding position," he says.

Blue Haze at The Kettle Club

WITH the last models of the Suzuki GT750 triples produced a quarter of a century ago in 1977, its riders need a well-organised club to provide support. The Kettle Club, formed in 1995, is primarily a social group according to events organiser Tony Norman, its top annual meeting being the aptly named Blue Haze Rally.

"We're less of a show-and-shine club," he says, "more a riding club." That said, its members, numbering close to 500 in the UK and Europe, are more keen on keeping their bikes in as good a standard condition as possible, rather than developing handling and performance. "They go for the original look," says Norman.

Spares come from a number of sources in the membership in addition to well-known names like Eddie Crooks. The most difficult items to obtain are exhaust systems.

Norman has got round this by having a batch of road-legal expansion chambers produced by Peter Gibson, who is based in Essex. "They are much lighter than stock, push up the power to about 80 bhp and improve the cornering clearance," says Norman.

A number of more exotic versions exist in the club, notably chairman Dave Pitcher's Sanders & Lewis race bike with a special frame and suspension.

More information about The Kettle Club from the membership secretary at 0208 641 5877 or from the web site at: www.thekettleclub.org.uk

Mouth watering line-up of Kettles at the club's Blue Haze Rally.

The infamous 'flexi fliers' of Sheene and company

INDIFFERENT handler the road-going GT750 might have been, but Suzuki made a works racing machine out of it. It was campaigned in Formula 750 between 1972 and 1976 by aces such as Paul Smart, Gary Nixon, Cliff Carr, Ron Grant, Stan Woods, Jack Findlay and John Williams.

And, of course, Barry Sheene, who hit the headlines when he crashed on the Daytona banking at 170 mph after a broken chain tensioner ripped the tread from the tyre.

Not without good reason was the XR11 (TR750) racer dubbed the 'Flexy Flier' for its wayward roadholding. But it was fast. When the F750 Triumph threes were making 79 bhp the Suzukis came out with 100 bhp. Eventually tuned to develop 116 bhp at 8250 rpm and drive through a six-speed gearbox, the 326 pound (148kg) bike was reported to have a top speed of nearly 180 mph.

Sheene and Woods came first and second in the MCN Superbike series in 1974 while brave John Williams won the Isle of Man Classic race in 1976.

Incredibly fast, the Suzuki triples were reckoned to top 180 mph on Daytona's banking.

offering his paint services professionally from his home near Wolverhampton.

Looking for a suitable section of road to take riding shots I was following photographer Dave Goldman's car at what I thought was a safe distance. He pulled up sharply to avoid another car but the Suzuki's front brake gave up the ghost.

Dave glanced in his rear view mirror to find it rapidly filling with GT750 and its rider mouthing profanities. "I wondered why you were aiming for the gap next to the kerb," he said. Too right.

Writing at the time I said: "The suspension lets the Suzuki down, especially this one. Displaying more than their fair share of stiction the front and rear shock only really work properly at speeds above 60 mph and offer a harsh ride and interference with the steering at town speeds.

"You wouldn't be advised to use the Suzuki for hard riding on country roads, either back in its heyday, and less so now. The stiff suspension, and exceptional weight, conspired to set up an incipient weave which would at high speeds expose itself at the slightest provocation.

"And how on earth did we get along with such skinny 3.25 x 19 and 4.00 x 18 bias-ply tyres?" Metzelers had been fitted, but there was just too much bike for them to provide adequate stability. "To some extent, the lack of cornering clearance - even by early 1970s standards - is a mixed blessing."

That wasn't all. The exhaust produced a smoke screen and the lights were poor. Even judged against its peers, the big Suzuki was a hairy beast.

To its credit the factory responded to the criticism. Before the following year's 1973 model was introduced a brake conversion kit was offered with dual hydraulic discs and this appeared on the GT750K along with detail alterations including chrome radiator covers, flexible mounts for the carburettors and finned exhaust clamps.

For the GT750L in 1974, the carburettors were again changed with CV types, a new air box and side panels.

Fuel consumption, ranging from 43 to 48 mpg hadn't been a problem but the new carbs were lighter and smoother in action. Styling changes included a chromed headlamp shell and dropping of the fork gaiters. A small gear indicator, along with the warning lamps, was mounted between the clocks. Despite the sportier look, performance was unchanged.

By now, other manufacturers' new bikes were showing up the Suzuki's modest performance. Suzuki was in the final stages of launching its rotary-engined RE5 and completing the development of its first four stroke, the GS750 four. It needed to inject a new lease of life into the GT750.

That was provided with a power boost and styling update for 1975. Longer timing, by raising the exhaust and transfer

The very first, launched in 1970. 'Styling straight out of Thunderbirds' - but watch out for that front brake.

ports and lowering the inlet, along with a slight increase in the corrected compression ratio to 6.9 to 1 and the fitting of larger 40mm-choke CV Mikuni carbs, raised and narrowed the power curve at the expense of flexibility. Peak power was lifted by three bhp to 70 bhp at 6500 rpm. A figure for peak torque wasn't revealed.

The styling changes brought the GT750 more in line with other models in the range with cleaner lines for the larger 3.75 gallon (17 litre) fuel tank and side panels. One-piece exhaust pipes with revised baffling and better cornering clearance were adopted.

The changes completely transformed the Suzuki and, although still bulky, provided a higher level of excitement. With a distinct leap in the power delivery at 4000 rpm, throttle response was better and acceleration improved through the gears, the ratios of which were raised to accommodate the extra power.

Suzuki GT750M specification

MODEL	Suzuki GT750M
ENGINE	Liquid-cooled two stroke triple
CAPACITY	738cc (70 x 64mm)
VALVE OPERATION	Piston-ports
COMPRESSION RATIO	6.9 to 1 (corrected)
LUBRICATION	Injection pump
IGNITION	Coil and contact breakers
CARBURATION	Three 40mm-choke Mikuni CV
PRIMARY DRIVE	Spur gears
PRIMARY RATIO	82/49 (1.673:1)
CLUTCH	Wet multiplate
GEARBOX	Five speed
INTERNAL RATIOS	2.846, 1.737, 1.364, 1.125 & 0.962 to 1
FINAL DRIVE	50HDSS 5/8 x 3/8in chain
FINAL DRIVE RATIO	43/16 (2.688:1)
OVERALL RATIOS	12.8, 7.81, 6.13, 5.06 & 4.33 to 1
PEAK POWER	70 bhp at 6500 rpm
PEAK TORQUE	na
FRAME	Duplex tubular steel cradle
FRONT SUSPENSION	Telescopic fork
REAR SUSPENSION	Pivoted fork, two spring-damper units with three-position adjustable preoad.
FRONT WHEEL	Laced spoke, steel rim
REAR WHEEL	Laced spoke, steel rim
FRONT TYRE	Bridgestone 3.25 x 19
REAR TYRE	Bridgestone 4.00 x 18
FRONT BRAKE	Dual 298mm-diameter discs
REAR BRAKE	190mm-diameter drum
ELECTRICAL SYSTEM	Alternator 280W, 50/40W headlamp, starter motor
BATTERY	12V-14AH
FUEL TANK	17 litres (3.75gal)
DIMENSIONS	Wheelbase 1492mm (58.75in), seat height 31in (787mm), castor angle 63-deg, trail 95mm (3.74in), weight 238kg (524 lb) with a gallon of fuel

Lively mover

THE GT750M I tested for *Motor Cycle* in August 1975 was the first Suzuki triple I'd ridden and I was surprised at how lively it proved to be, bearing in mind its reputation.

Turbine-like power from the rubber-mounted engine, smooth controls and a relaxed riding position at both low and high speeds all added up to a bike that was both practical and fun. On motorways you could hum along at 100 mph and still have a range in excess of 150 miles.

It wasn't perfect by any measure. The gearbox was clunky, particularly if the drive chain needed adjustment. The suspension still needed improvement with a front fork action that was soft and under damped yet rear shocks that had too much damping and offered a poor ride on ripply surfaces.

It was humid and hot when I took JGH 957N to MIRA's timing straight for the performance testing and we were amazed when the beast outran Kawasaki's 750 H2 and the Triumph Trident to become the fastest 750cc roadster of its day.

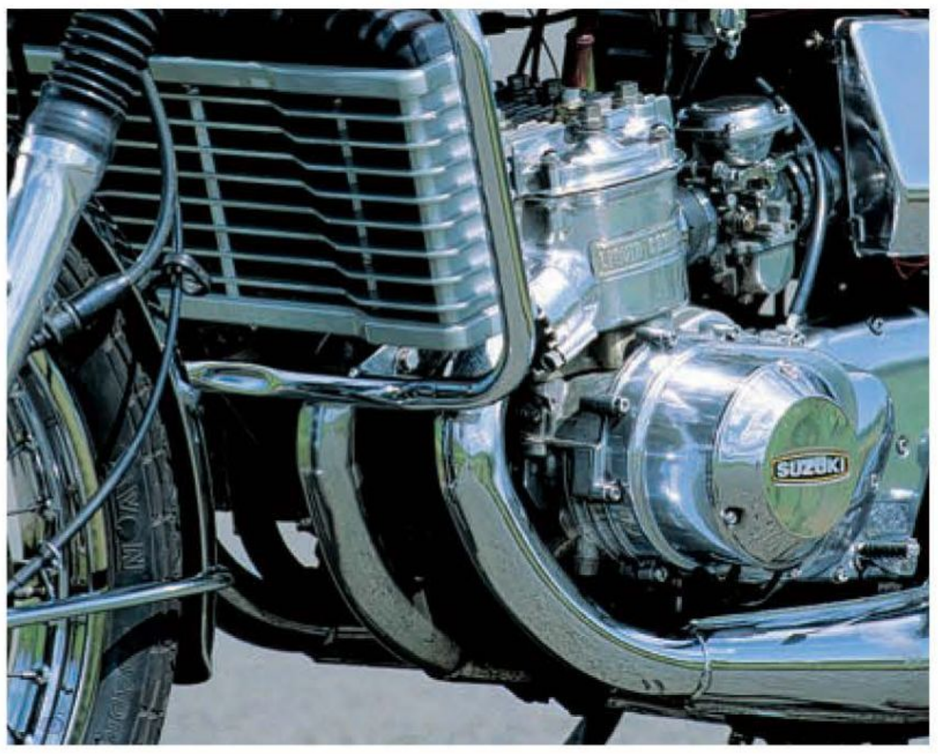
Overall gearing had been modified by a higher final drive ratio of 43/16 to give 120 mph at 6500 rpm and this turned out to be almost spot on. With the rider prone it produced a best one-way speed of 120.39 mph and a two-way average of 119.84 mph.

Flat out acceleration was much better too, with an average standing quarter mile time of 13.5 seconds and a terminal speed of 99.54 mph, about half a second less than the earlier models. The higher internal ratios had been closed up to ensure that the engine was kept spinning in its narrower power band.

With little in the way of engine braking from the triple it was just as well that the dual front discs were up to the job, but they weren't that great, only giving a stopping distance of 30.5 feet (9.3m) from 30 mph. I couldn't test them in the wet because it didn't rain but the small sticker on the fork leg - suggesting that performance would be less than expected - said it all.

For 1976 the GT750A version had a larger fuel tank with a locking cover and a number of small cosmetic changes. Now competing with the faster and better handling four stroke GS750, it was a matter of time before emissions regulations would call the death knell. According to the Kettle Club, this was the best-selling GT750 model.

Parts rationalisation brought the final version, the GT750B of 1977, in line with the GS750 with common components such as the plastic headlamp shell, rear lamp



FAR RIGHT: Huge radiator and fan kept the temperature at around 80 degrees.

Kettle Club chairman Dave Pitcher's Sanders & Lewis race bike with special frame and suspension.

unit, indicators, front mudguard and side panels.

The GT750's reputation lives on in Europe guarded and promoted by members of the Vintage Japanese Motorcycle Club and The Kettle Club. Both provide a social network, technical support and access to the dwindling supply of spares.

Two stroke triples offer a unique riding experience that is epitomised by the GT750. It's just a shame that it was outlawed by emissions regulations rather than lack of technical prowess.

Suzuki GT750 performance data

All figures compiled at Motor Industry Research Association's proving ground, Nuneaton, Warks.

MODEL:	Suzuki GT750M
DATE OF TEST:	4 August1975
REG NO:	JGH 957N
CONDITIONS:	Humid, warm light cross wind
MEAN TOP SPEED (MPH)	119.84
BEST ONE-WAY (MPH)	120.39
MEAN NORMALLY SEATED (MPH)	110.15
STANDING QUARTER-MILE: (MEAN, SECS/MPH)	13.50/ 99.54
ACCELERATION (SECS/MPH)	
110YARDS	4.85/63.1
220YARDS	8.15/81.7
330YARDS	11.2/91.9
CONST SPEED MPG@MPH	
30, 50	75.2, 57.6
70	49.6
BRAKING DISTANCE (FEET) (FROM 30MPH)	30.5ft (9.3m)
TURNING CIRCLE (FT)	15.5ft (4.7m)
SPEEDO ACCURACY, ACTUAL MPH AT INDICATED: 30, 50	28.6, 46.5
70, 90	64.7, 84.0
TEST WEIGHT (1GAL FUEL):	na
OVERALL TEST MPG	45.3
SPEED IN GEARS AT 7000 RPM RED LINE	40.4, 66.2, 84.3, 102.2 and 119.5mph

FAR LEFT: At MIRA the GT750 surprisingly outran Kawasaki's 750 triple.

Riding with the GODS

Honda's six-cylinder CBX was not the quaint aberration it's regarded as by many today. When launched in 1977, it was a stunning demonstration of what the world's largest motorcycle manufacturer was capable of - and John Nutting was there.

WE all have those defining moments when we can remember just where we were at a pivotal moment in time. Such as when JFK was assassinated, Elvis died, or when I heard the news that my hero Jarno Saarinen had died with Renzo Pasolini at Monza in 1973.

And so I can recall with crystal clarity the moment when I was told about the imminent launch of Honda's phenomenal CBX. It was during an evening press presentation after we'd been trying out the CX500 vee-twin at the Nogaro racing circuit in France in the summer of 1977. We were handed monochrome photographs showing an across-the-frame six-cylinder road bike. We were gobsmacked. It couldn't be true.

When we batted on different sides. Bob Berry on the MCN test CBX in 1978.

Six-cylinder machines of any kind were the stuff of dreams. I'd seen the shrieking 250cc and 297cc sixes that Mike Hailwood and Jim Redman had raced during 1965 and 1966 when I'd been to the Isle of Man TT. They were beyond reach, ridden by Gods.

Yet here we were, being told that soon we would be able to ride, on the road, a 1047cc 24-valve six developing 105 bhp at 9500 rpm in just a few months time. It took a while to sink in.

Words/Pictures: John Nutting

I had about five months to prepare myself for the moment, but at the press launch at Honda's Suzuka circuit in November 1977 it was nothing less of a shock to see the bike in the flesh.

It was the first time that Honda had hosted a launch in Japan. It was taking no chances. The CBX was the top of a new range of machines that included revamped twins and 16-valve dohc fours and the unusual CX500, a pushrod watercooled Guzzi-styled vee-twin.

More than anything else Honda wanted to prove that it had the technological resources to master any kind of engine format. At the time motorcyclists were lusting for bigger fours that handled more confidently than in the past. Suzuki and Yamaha had revealed their GS1000 and XS1100 models. Honda went one better. The words Honda and six became synonymous again.

The 'Motor Cycle' CBX which clocked over 136 mph at MIRA.

Monster bike

THE first question that begged an answer was how could such an engine be mounted in a motorcycle and leave enough room for cornering clearance? Back-of-envelope calculations suggested that 64.5mm (2.54 in) diameter

Riding with the Gods - a heavenly experience at the time.

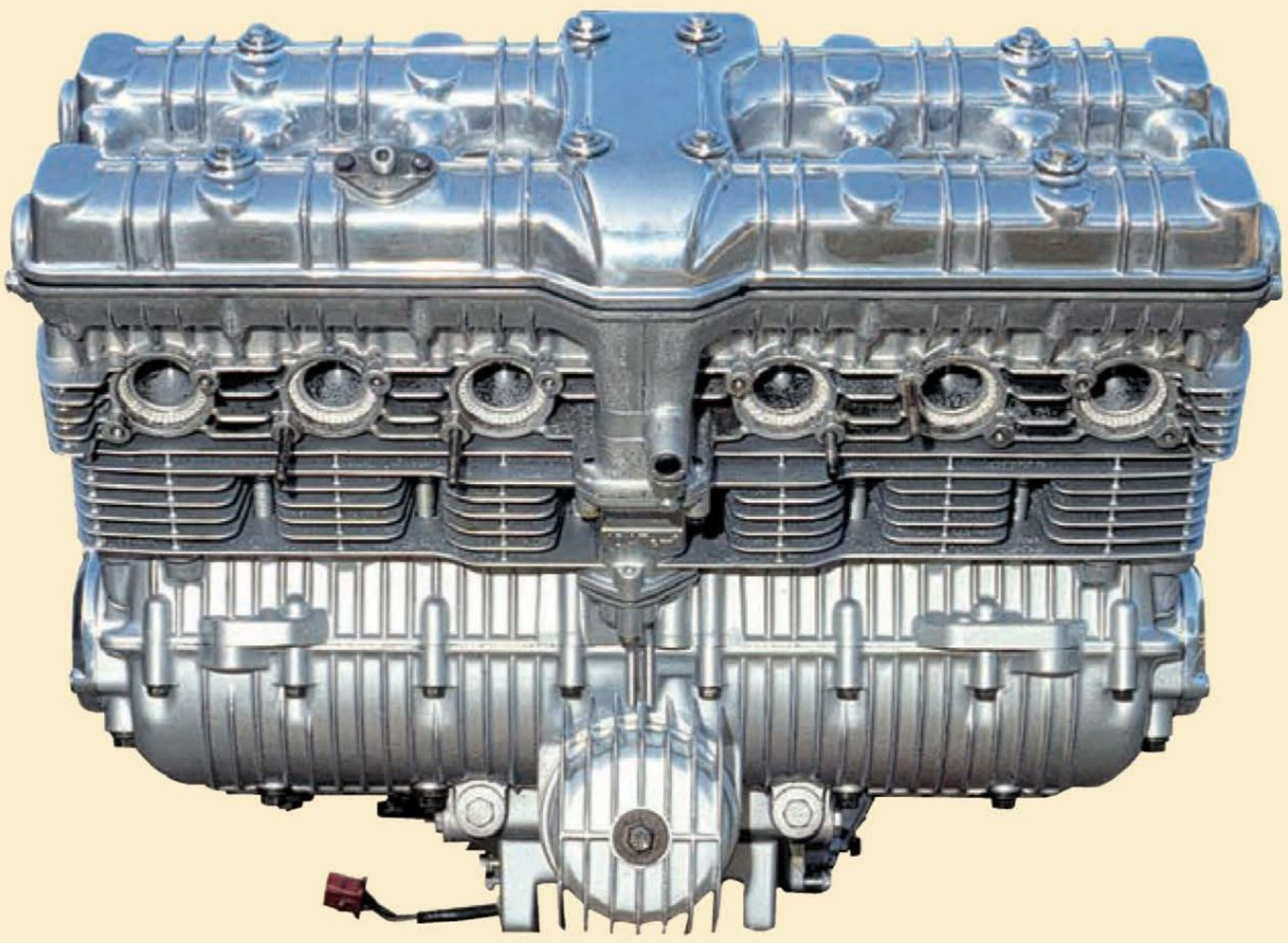
That massive engine. This infamous motor was rebuilt three times in Mechanics - there's better advice around now...

pistons pitched at the required 1.4:1 spacing for an aircooled engine would require a width of at least 60cm (23.5 in) across the fins. Yet that wasn't much different from the Suzuki GS1000's width.

Cleverly, Honda's project chief Masahuri Tsuboi took a leaf out of Shoichiro Irimajiri's design thoughts with the original racers.

He mounted the generator and ignition systems on a shaft behind the cylinder block, through which the drive was taken from the forged one-piece crankshaft by an inverted-tooth chain and thence by gears to the clutch and five-speed gearbox.

To shave precious inches from the cases for cornering clearance, the outer webs of the crank were chamfered along with the cases. The weight of the cylinder head with its four valves for each combustion chamber was reduced by using hollowed camshafts.



Remarkably, the engine didn't impinge on the rider, apart from the view of the cam covers poking out either side of the fuel tank. The cylinders were canted forward and the six 28mm-choke CV carbs mounted in a vee-shape as they entered the airbox, although this reduced the volumetric efficiency of the outer cylinders, as the jetting variations showed.

Wasp-waisted, the CBX was slim across the nose and footrests and, with canted-back handlebar forgings, felt eager to go.

Even with an all-up weight of 558 pounds (think about that, about 100 more than a Hayabusa) the CBX felt light to steer and snapping the throttle open made the engine respond suddenly with a symphony of melodious exhaust sound. It was crisp, tight, smooth and immediate. I felt like I was about to ride with the Gods

Retrospectively, it's hard to believe that the designers were happy to provide the CBX with spindly 35mm-diameter fork legs, tiny brake discs and fibre bushings for the swinging arm.

Yet they did and the assembled bike journos happily applauded the handling. The steering was neutral and the cornering stable right to when the footpeg tips were skimming the road. We were so overwhelmed by the experience that the incipient weave induced by modest bumps was regarded as only a minor irritation.

Daily dream ride

IT was more than six months before I was able to find out if the claims of a 140 mph top speed were really true. Day-to-day use of Honda UK's metallic red test bike was as undramatic as you'd expect, except that this time you had to face a constant barrage of questions every time you stopped. No problem, just part of the responsibility of being a bike God.

Changes from the prototypes I rode at Suzuka included a different cylinder head with two additional studs and

20 percent softer springs on the rear shocks. These were adjustable with three rebound damping rates and two for compression. Ride comfort was improved but the changes did nothing for the rear end's waywardness on choppier surfaces.

The conditions on the MIRA timing straight in July 1978 couldn't have been much better, with a slight downhill tail wind to provide that always-welcome boost to the top speed which could be used to silence bar room arguments.

Not that we at *Motor Cycle*, the weekly paper, resorted to exploiting one-way figures... much. Sometimes, for example when the Laverda Jota broke through 140 mph, it was worth trumpeting the fact. But for making worthwhile comparisons between bikes of their top speed, only the two-way average had any meaning because the effects of gradient and wind were more or less cancelled out.

Only on the rare occasions when there was a severe cross wind, which reduced the speeds in both directions, or when there was standing water on the road surface, did we postpone the testing.

After checking the CBX's speedometer accuracy against the timing gear, I whipped the bike off down the strip to find out the top speed in a normal riding position. At the speeds the CBX was capable of it was a bit daft really, because there's nothing normal about the way you sit on a naked motorcycle at more than 120 mph.

Anyone in their right mind would be flat on the tank and

Suzuka race track, Japan, late 1977 and the bike world sees the incredible six for the first time.

Engine was canted forward and slung beneath a diamond-shaped frame with no front downtubes to spoil the view.

trying to evade the howling two-miles a minute gale. But in the interests of discovery and truth, I persevered and did my best to adopt a bag-of-potatoes stance in the face of a force ten. The tail wind helped a little and the bike clocked a remarkable 126.44 mph. Spinning the bike around I set off in the breeze but struggled and clocked just 119.29 mph for a two-way average of 122.9 mph.

It was a bit hypothetical because the bike was as aerodynamic as a brick, the huge width of the engine providing a very effective air dam.

Nowadays, 100 bhp from a 600cc four with a slinky fairing is enough to push a bike through the air at 160 mph or more in the right conditions.

Back in 1978, fairings were still in their infancy and rarely designed with good, and well tested, aerodynamics in mind. Naked bikes were the norm rather than having a niche-market of their own. And with its engine dominating everywhere you looked on the bike, the CBX was the epitome of mechanical nakedness.

That was the point. Honda wanted to prove that it could make a road-going litre-plus machine with six cylinders. Six cylinders you could see and ogle.

So it was all the more remarkable that the CBX delivered its performance as well as it did. Following the normally-seated runs I took off the rear-view mirrors (as an aid to steering stability) and aimed the bike down the strip, tucking in behind the instruments, holding the twistgrip wide open and gripping the left fork leg in the manner of a Stateside flat tracker.

On the first run the big six revved to 9950 rpm in top, clocking 137.24 mph. Against the breeze it managed 128.89 mph for an average of 133 mph. I thought it could do better. The next downhill run returned 139.19 mph (10,100 rpm), the best of the day. But there was more to come against the wind with a best of 133.86 producing an average top speed of 136.53 mph.

From the first time I rode the bike in Japan, it felt like a great quarter-miler for all its weight. It would lift the front wheel under power but the real challenge was quick standing starts without spinning the rear tyre too much.

The first quarter downhill returned 11.9 seconds with a terminal speed of 116.79 mph. I'd dropped the clutch too quickly and lost time in spin.

So I gave it full welly the next time to really heat up the tyre and it had the desired effect. Carefully balancing the clutch against the traction the bike flew through the lights in 11.6 seconds with a terminal speed of 117.44 mph that wasn't bettered. Uphill the best was 11.9 seconds at 115.14 mph.

The average was 11.75s and 116.3 mph, enough to beat Suzuki's GS1000 despite its 20 pounds lighter weight on which I'd recorded 12.4s at 110.3 mph two months earlier.

The intermediate times and speeds also gave some indication of just how quick the CBX was for the time. From a standstill it could cover 110 yards in 4.85 seconds at a speed of 73 mph. The 220-yard mark was reached in 7.65 seconds and 93 mph. It took just 9.9 seconds to cover 330 yards at over 106 mph. Nothing could touch it.

US model test

THE next CBX I rode was a black US model that was being tested by *Cycle World* magazine when I was technical editor late in 1979. This bike had taller handlebars and more softly tuned engine, along with much-heralded improvements to the chassis. The swing arm pivot shaft was increased from 14mm to 16mm diameter and was supported in a needle roller bearing on the drive side, matched by ball bearings on the other side.

Tyre sizes remained the then traditionally-sized tubeless 350 V 19 front and 450 V 18 Dunlop Gold Seals, mounted on aluminium composite Comstar wheels, but the rear rim was increased in width from 2.15 to 2.50.

Part of the reason why Honda's engineers had detuned the engine-valve lift (down by 0.5mm for inlet and exhaust to 7.8mm and 7.0mm respectively) and duration, relates to the combined effects of an agreement in Germany that limited peak power to 100 bhp, and a need to meet tighter emission regulations. But that didn't account for an almost 20 percent loss in power for the US models.

So it didn't take long before the four-cylinder competition caught up in the performance stakes and the

Honda CBX specification

MODEL	Honda CBX
ENGINE	Aircooled 24-valve in-line six
CAPACITY	1047cc (64.5 x 53.4mm)
VALVE OPERATION	Double overhead camshafts
COMPRESSION RATIO	9.3 to 1
LUBRICATION	Wet sump, 5.5 pint capacity
IGNITION	Transistorised, magnetically triggered
CARBURATION	Six 28mm-choke VB
PRIMARY DRIVE	Inverted-tooth chain and gears
PRIMARY RATIO	2.269 to 1
CLUTCH	Wet multiplate
GEARBOX	Five speed
INTERNAL RATIOS	2.438, 1.750, 1.391, 1.200, 1.037:1
FINAL DRIVE	5/8 x 3/8in chain
FINAL DRIVE RATIO	2.333: 1 (35/15)
OVERALL RATIOS	12.9, 9.26, 7.36, 6.35 & 5.49 to 1
PEAK POWER	105 bhp at 9000 rpm
PEAK TORQUE	60 lb-ft at 8000 rpm
FRAME	Duplex welded tubular steel spine type
FRONT SUSPENSION	Telescopic fork, 35mm legs
REAR SUSPENSION damper	Pivoted fork, two spring-units with three-position adjustable preload and damping adjustment
FRONT WHEEL	Aluminium-alloy Comstar
REAR WHEEL	Aluminium-alloy Comstar
FRONT TYRE	3.50V19
REAR TYRE	425V18
FRONT BRAKE	Duplex disc
REAR BRAKE	Single disc
ELECTRICAL SYSTEM	Alternator 240W, 60/55W H4 headlamp, starter motor
BATTERY	12V-14AH
FUEL TANK	20 litres (4.4gal)
DIMENSIONS	Wheelbase 1495mm (58.9in), seat height 810m (31.9in), castor angle 62.5 deg, trail 120 mm (4.7in), weight 247kg (544.5lb) claimed

American model of late 1979 was almost 20 per cent less powerful.

idea of what was, in effect, a cartoon image of an exotic motorcycle started to wear thin.

Nowadays, very sophisticated motorcycles that make huge demands on the rider's road skills and expensive servicing are commonplace. But they perform. The blistering super-nova that was the CBX started to dim.

But it didn't go out completely. Honda revived the machine for the 1981 market as, of all things, a tourer with a fairing in the same style as the CB900F2 and a set of pannier cases. To reduce valve gear noise and beef up the mid range, another set of camshafts were fitted, this time with lift increased again to 8.0mm and 7.5mm.

But the best part was the upgrading of the chassis and suspension, much of which would have been welcome on the original CBX. Wheel rim widths were upped to 2.50 x 19 and 2.75 x 18 while the fork legs were increased in diameter to 39mm. At the rear, a single-shock Prolink system was offered. Braking was improved by the use of larger-diameter ventilated discs gripped by twin-piston calipers.

It wasn't enough and the CBX faded away during the early Eighties, as did Kawasaki's even heavier Z1300 offering.

The appeal of the CBX has revived however. Other six cylinder machines such as the latest Gold Wing and the Valkarie have remained in the range, but have none of the raw in-your-face style of the across-the-frame engine.

Of the groups that support the CBX's continuing popularity is the CBX Riders Club (UK) which is run by Mel Watkins (tel: 01745 827026), who provided useful help in tracing much of my original material.

Six cylinder engines are wonderful in a motorcycle, and could still be revived in a format imilar to the CBX's. Just imagine it if watercooled and more compact. A vee-five sports machine derived from the works MotoGP bikes might offer the best performance, but it would look just the same as any other.

No, let's see a straight six, and bring on the noise!

Honda CBX performance data

All figures compiled at Motor Industry Research Association's proving ground, Nuneaton, Warks.

MODEL:	Honda CBX
DATE OF TEST:	6 July 1978
REG NO:	ALP 892S
CONDITIONS:	Fine, 3/4 cross wind
MEAN TOP SPEED (MPH)	136.53
BEST ONE-WAY (MPH)	139.19
MEAN NORMALLY SEATED (MPH)	122.87
STANDING QUARTER-MILE: (MEAN, SECS/MPH)	11.75/ 116.29
ACCELERATION (SECS/MPH)	
110YARDS	4.70/73.4
220YARDS	7.65/93.6
330YARDS	9.90/106.9
CONSTANT SPEED MPG@MPH	
30, 50	64.0, 46.4
70	38.4
BRAKING DISTANCE (FEET) (FROM 30MPH)	27.5
TURNING CIRCLE (FT)	15
SPEEDO ACCURACY, ACTUAL MPH AT INDICATED: 30, 50	28.7, 48.4
70, 90	68.9, 87.1
TEST WEIGHT (1GAL FUEL):	558lb (254kg)
OVERALL TEST MPG	32.5

Head-banging hedonism

How mixing and matching various performance parts extracted over 115 mph from John Nutting's test 250. And when they converted it to a 350 it tripped the lights at over 132!

Originally printed in the February 2003 issue of *Classic Motorcycle Mechanics*

HARD to believe, it's true, but it's more than three decades since the bike that spawned a generation of head-banging hedonists was first released to an unsuspecting motor cycle world.

Yamaha's liquid-cooled (LC) two stroke twins came out in 1980 and immediately turned our fantasy of riding race machines on the road into a red-mist reality.

While their aircooled predecessors — developed over a period of 15 years — had been fun, the 250cc and 350cc LCs were in a different league. Liquid cooling enabled power to be boosted to 35 bhp and 45 bhp respectively with the opportunity for easy tuning. And for those still on L-plates the smaller model offered the prospect of a genuine ton-plus bike straight from the showroom floor.

Those familiar with the LCs — and there is still a strong following after all these years — will know what makes them a blast to ride. But for the unconverted it's worth recalling just what made them such a revolutionary development.

I'd just come back from a spell working in California to join the monthly *Which Bike?* as editor when the bikes were launched, so much of the fuss had passed me by. But when we picked up the first RD250LC test bike in May 1980 it was obvious that it was something special, and quite intoxicating. Forsaking the traditional style of the aircooled models, the LC offered a glimpse of the future and the chance to ride on the wild side. It had a lithe and sinister style with sleek expansion-chamber style exhausts, cantilever single-shock rear suspension and a wicked sound. It interrupted your senses: a modest exhaust note turned banshee when the subtly-smooth rubber-mounted engine hit its power band. For the two stroke junkie, life would never the same again.

Our man in production race action on the 250LC at Brands.

And yet it came with some of the home comforts. Locks were provided for the fuel tank, seat, steering and your helmet. The tool kit was reasonably generous; there was an engine temperature gauge, a 120 mph speedo and rev meter reading up to 12,000; but no electric starting — that would have been anathema.

With a duplex-loop steel frame and cast alloy wheels, the LC was substantially built but the extensive use of plastics (engine side covers, headlamp shell, tail lamp cover, radiator cover, chain guard and seat base) kept the all-up weight low. At 371 pounds with a full tank the LC was almost 30 pounds lighter than much of its immediate competition.

A model of simplicity, the LC engine owed much to its predecessors, the bottom end comprising a built-up crank running on ball bearings, gear primary drive and a six speed all-indirect gearbox.

Changes included the coolant pump on the primary drive and the capacitor-discharge ignition system at the opposite end. Individual cylinder barrels were used but the coolant plumbing was kept at a minimum by having the pump draw the coolant from the barrels through the cases. A single cylinder head casting contained the thermostat and the feed back to the top of the radiator.

Like the aircooled engines, the LC used reed inlet valves, fed by a pair of linked 26mm Mikuni carburettors, which in turn drew air through a large filter under the 16-litre fuel tank. Lubrication was, like the earlier engines, by means of a pump, controlled by engine speed and throttle opening that fed oil to the inlet tracts from a tank under the seat.

Access denied

BECAUSE *Which Bike?* didn't have access to MIRA's proving ground in 1980, I was unable to properly test the performance of the first 250LC we received at the magazine, reg no RGN 166V. We used the seats of our pants to assess performance. My records, however, show that the fuel consumption was 40.5 mpg, and that was it.

By the next year however, *Which Bike?*'s publisher had subscribed to MIRA's facilities and I was able to resume my testing of machines in a more scientific fashion, a process that had been interrupted when I left *Motor Cycle Weekly* in 1978.

Yamaha too had changed in 1981 and a more generous marketing budget meant that we were not only to enjoy the use of a pair of new TY175 trials bikes and a TZ125 road racer, but to have an RD250LC on long-term test.

This was duly collected (AGT 741X) from importers Mitsui in September 1981 and was run-in with a brisk jaunt to Wisbech in Cambridgeshire and back.

Surprisingly it took until the end of the following month to complete the first 1000 miles, but after a service at Mitsui, I took it along with three other 250cc machines - a four stroke single Honda CB250RS, two stroke triple Kawasaki KH250B5 and a four stroke twin Suzuki GSX250E - for the definitive comparison test at MIRA.

Words/Pictures: John Nutting

A chance to ride on the wild side - a lithe and sinister style.

It proved, as we suspected all along, that the Yamaha's performance was streets ahead. While the others clocked top speeds of around 88 to 90 mph, the 250LC's mean top speed was 98.8 mph, with a best one-way speed of 102.5 mph. It was miles ahead in acceleration too, with a quarter-mile time of 15.45 seconds and a terminal speed of 83.9 mph. The others were well behind with times and speeds in the mid 16s at around 75-76 mph.

The 250LC was also significantly faster than any of the 250cc aircooled two stroke twins I'd tested in the Seventies. The fastest of these had been the Suzuki GT250C in 1978 with a top speed of 94.77 mph and quarter mile figures of 15.80s and 79.9 mph.

Riders had a clear choice. The Yamaha offered stunning top speed and brisk throttle response, provided you revved it, used the gearbox and were prepared to accept what was then regarded as heavy fuel consumption. The 250LC recorded 41.6 mpg, giving a range of 120 miles. In contrast, the more leisurely four stroke Honda single and the Suzuki twin returned a miserly 69 mpg.

Modified ride

HEY, but we liked to think we were closet racers, and so started a number of modifications that would improve the handling and end with the bike flying through the timing lights at more than 132 mph. How? Read on.

This of course would call for a number of engine and chassis modifications but we also wanted to go production racing with the bike. This meant that while as a road bike it would receive all the tweaks we know and love, the 250LC had to be returned to a trim that enabled it to pass the production race scrutineers.

First step on the path to happier riding included the replacement of the original Yokohama tyres with Dunlop K181s and changing the front brake hose to a braided stainless steel item from Goodridge. While this latter change sharpened up the feel a little, the brake, using a single-piston floating caliper, was never brilliant.

By now the bike was being used in the dead of winter and slow road work during commuting exposed the weakness of the ignition system which couldn't keep the plugs clean. This was virtually cured by the use of platinum tipped B8ES NGK plugs.

The exhaust pipes also started to leak oil from the joint at the cylinders. Some flexibility was necessary because the engine is rubber-mounted, but the compression seals became too squashed, allowing the pipes to rattle and the oil to weep. It was cured by dispensing with the gaskets under the outer clamp, a move that held the pipes more securely but at the expense of transmitting more vibration.

Over the winter months the bike received scant attention apart from topping up the oil and fuel and lubricating the cables with WD40.

But I was nonetheless shocked when I steam cleaned the bike the following March.

Although it had just 2800 miles on the clock, the clean-up had exposed the 250LC's poor quality of finish. Bare metal was showing on the rear fork and frame welds while the alloy wheel rims were deeply pitted. I used the opportunity to try out powder coating, but in dismantling the rear fork I also found that the shock mount was almost completely seized.

There was another shock in store. After a brisk motorway run (let's say I saw 90 mph on the clock for some time) I stopped for fuel and while checking the bike over found that the whole rear end was bathed in oil from the gearbox.

Yamaha RD250LC

The 250 LC Graham Curtis restored in Mechanics a few years ago.

Performance comparison, 250cc machines, 27 October 1981

MODEL	Honda CB250RS	Kawasaki KH250B5	Suzuki GSX250E	Yamaha RD250LC
MEAN TOP SPEED, PRONE, MPH				
	88.2	89.4	89.7	98.8
MEAN TOP SPEED, NORMALLY SEATED, MPH				
	78.1	80.2	77.4	87.9
STANDING QUARTER MILE, SECS				
	16.74	16.66	16.83	15.45
TERMINAL SPEED, MPH				
	75.8	76.7	75.7	83.9
SPEEDS IN GEARS				
1st	29	29	29	33
2nd	43	40	44	48
3rd	58	53	59	64
4th	72	64	72	78
5th	86	75	83	88
6th	-	-	91	95
AVERAGE MPG				
	69.3	48.7	69.4	41.6
WEIGHT, FULL TANK, LB				
	329	399	399	371

Suspecting a collapsed bearing behind the sprocket I took a close look but everything was in order. It turned out that the gearbox had been overfilled at the last service and the sustained speed, and possibly a blocked breather, had raised internal pressure enough to force the oil past the oil seal.

Other mods to improve the handling included a slider brace and stiffer springs. The front end was comfortable, but with skinny 32mm legs and soft springs, could be bettered. So at first air valves were used but a better fix was constant rate 24 lb per inch (rather than the standard multi-rate 19-30 lb/in items) that also increased the ride height and stiffened the action.

By now a number of aftermarket exhaust systems had become available. So in our quest to inform *Which Bike?* readers of the best choice, we took the bike to MIRA with a selection of three from Allspeed, J&R and Micron which we tested against the original system for performance and noise levels.

To ensure that we were starting from a level playing field the bike was fitted with a set of new standard pipes. At 99.7 mph the mean top speed was marginally better than when the bike had been tested eight months earlier and the quarter mile figures almost identical at 15.6s and 84.0 mph.

I was concerned however that while the maximum speed runs would offer a measure of any peak power improvement offered by the pipes, a standing-start acceleration test would only back up the test. To show how power spread had been affected I decided to test the pipes using a rolling test through the quarter mile from 40 mph in top gear. This gave an elapsed time of 14.2 seconds and 84.4 mph for the stock bike.

Noise testing was by using the then homologation process of accelerating the bike past a noise meter from 30 mph in third gear, in both directions. It was surprising how different to two figures were.

As the figures show, the best peak performance was provided by the Micron pipes with a mean top speed of 103.3 mph and acceleration of 13.6s/84.4 mph. But the noise levels were well over the limit at 91/99dB. A better compromise was offered by the Allspeed pipes that gave the engine a better spread of power, improving better acceleration through the quarter mile to 13.5s at 87.3 mph, at the expense of a slightly lower mean top speed (that was still better than stock) of 100.9 mph.

During the summer of 1982 I had some fun on the bike in production racing at Brands and Snetterton, but modesty prevents me from revealing the results. To perk up the performance we tried out ported barrels from Stan Stephens and Rich Dickenson but because of time limitations we were unable to test them at MIRA.

For racing the bike was fitted with KR124 racing covers from Dunlop which, being wider and stickier than road tyres, put remarkable stresses on the chassis and made the bike even more unstable in a straight line.

We also played with the cosmetics, and to find out what the 250LC might be like with the full cafe racer treatment took it along to Mel LeMoto in, as I recall, Rochester, where Tom fitted a lovely alloy tank, racing fairing, single seat, rear sets and clip-ons.

It looked brilliant and probably improved the aerodynamics dramatically. Why? Overall fuel consumption improved from around 41 mpg to 48 mpg (that suggests a reduction in drag of 17 percent), but why we never really put it to the test at MIRA, I can't remember.

At the end of the season we had more time, so between September and November took the bike and a number of special parts to MIRA to test the various combinations.

So many claims had been made for alternative inlet reeds

that we had to try those offered by Boyensen and Stephens, using top speed and acceleration from 30 mph in top gear. Neither had any appreciable effect on top speed but mid range was better from 6000 to 8500 rpm.

Later we went back to the stock settings and started again. First of all I removed the air filter and found a startling improvement in standing quarter acceleration to 14.8s at 87.7 mph. But the top speed was no better at 99.5 mph. Suspecting it was running lean, we jetted up with 240 mains, removed the airbox entirely and immediately found an extra mph.

But we wanted more. Stan Stephens offered a pair of modified barrels and head with longer exhaust and transfer timing, as recommended in a Yamaha factory tuning sheet. Stan fitted these along with some special inlet reeds from Hargreaves, and Allspeed pipes, and we immediately found an extra seven mph over stock, recording a mean top speed of 106.3 mph on the standard final drive gearing of 16/41. Standing quarter was further improved to 14.43 seconds at 93.73 mph.

To find out what the Allspeed pipes had contributed to this we refitted another fresh set of standard items. Result? Less top end but heaps more mid-range: top speed dropped to 105.56 mph while the quarter mile dropped to 14.8 seconds.

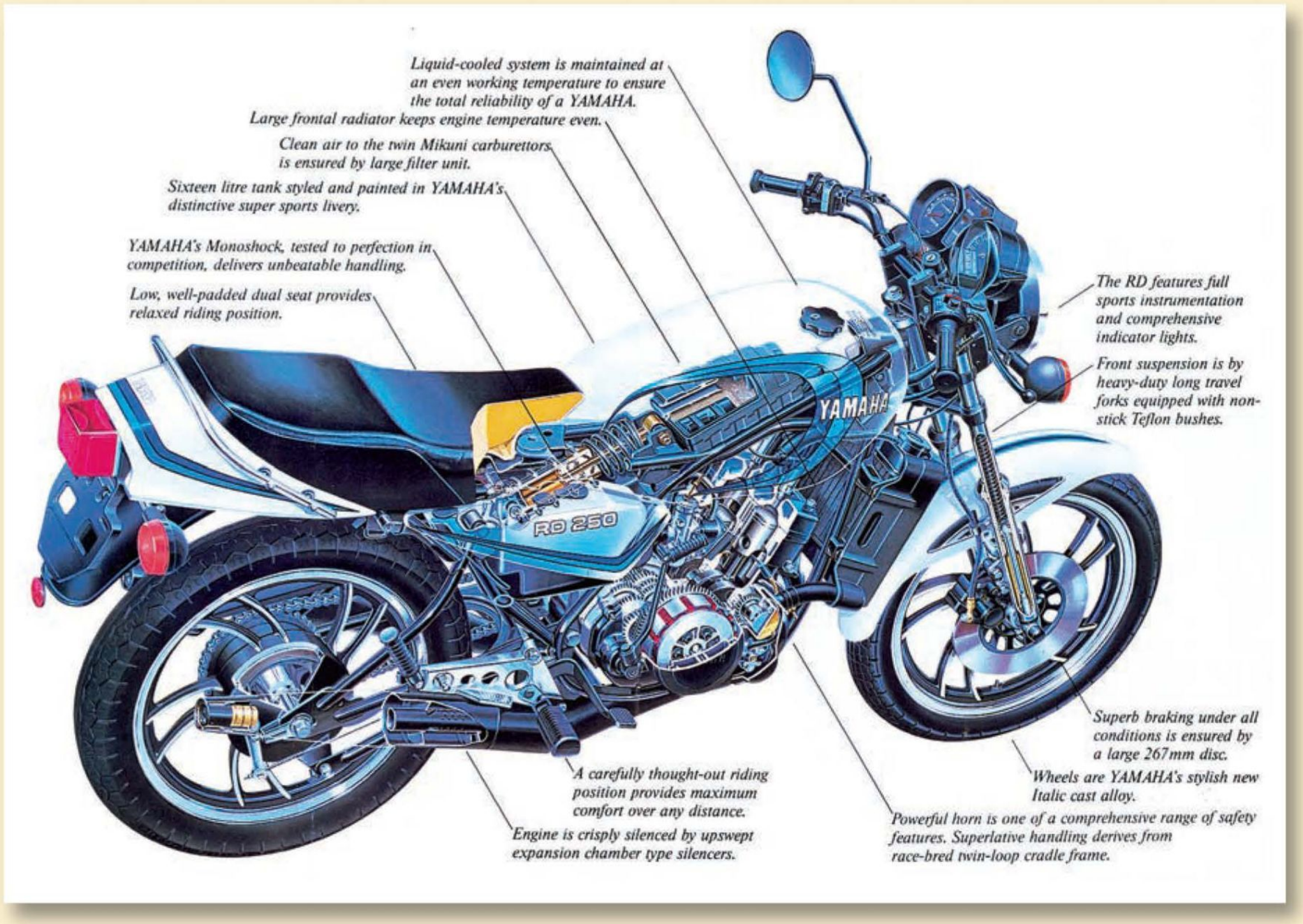
With a slight tail wind, one of the two runs had been at 111.09 mph but with more than 10,000 rpm on the rev counter it felt as if it was well beyond its power peak. So we raised the gearing two teeth on the rear sprocket to 16/39 by using a wheel from a 350. It had the right effect, increasing the mean top speed to 107.62 mph. Unsurprisingly, acceleration suffered, the quarter mile dropping to 14.52 s at 91.9 mph.

We also tried some barrels with porting modified by Rich Dickensen with even longer exhaust port and transfer timing. These gave strong and smooth power from 6000 to 9500 rpm on the stock pipes but the power dropped off abruptly, so the top speed was lower at 107.12 mph. Acceleration improved again to 14.34s at 91.34 mph.

We were making progress. The engine felt rich though so 190 mains were fitted with the needle in the lowest notch. The result was amazing with the mean speed raised again to 110.21 mph and the quarter mile reduced again to 14.32 seconds.

But the Allspeed pipes were still in the truck. How would they work with the Dickensen barrels? Minutes later they were fitted and I was flying down the strip, the bike feeling as if it was rocket propelled. With a best one-way speed on

Although they used many performance parts for road testing - on the track it had to conform to the rules.



Official factory brochure cutaway drawing.

Yamaha RD250LC

the high gearing of 115.29 mph and a mean of 111.44 mph the 250LC was developing in the region of 25 per cent more power and this was reflected in a quarter mile time of 14.15s at 93.45 mph.

Squeezing more power out

BUT there was more. With the lower standard gearing the time dropped even more to 13.8s at 94.75 mph, approaching that of a standard 350LC's time of 13.16s at 99 mph. So, you might ask, why not just tune a 350 instead? Remember that we'd been trying to find what could be extracted from a 250LC, the best-performing machine available to learners and a good machine for production class racing.

But yes, a tuned 350 would be better still and it just so happened that Stan had all the bits to put one together. The performance box showed what happened but the upshot is

In 1981 the standard 250 clocked 98.8 mph.

RIGHT: The LC used reed inlet valves fed by a pair of 26mm carbs.

Standard pipes were tested as a comparison to aftermarket sports systems.

The 350 version grew a second front disc.

Yamaha RD250LC specification

MODEL	Yamaha RD250LC
ENGINE	Liquid-cooled two stroke parallel twin
CAPACITY	247cc (54 x 54mm)
VALVE OPERATION	Piston ports with reed inlet valves
COMPRESSION RATIO	6.2 to 1 (from exaust port closure)
LUBRICATION	Injection pump
IGNITION	Capacitor discharge
CARBURATION	Two 26mm Mikuni carburettors
PRIMARY DRIVE	Spur gears
PRIMARY RATIO	2.87 to 1 (66/23)
CLUTCH	Wet multiplate
GEARBOX	Six speed
INTERNAL RATIOS	2.571, 1.777, 1.318, 1.083, 0.962 & 0.889 to 1.
FINAL DRIVE	520 chain
FINAL DRIVE RATIO	16/41
OVERALL RATIOS	18.8, 12.9, 9.72, 7.97, 7.07 & 6.54 to 1.
PEAK POWER	35.5ps at 8500 rpm
PEAK TORQUE	3.1 kgm at 8000 rpm
FRAME	Tubular steel duplex cradle
FRONT SUSPENSION	Telescopic fork
REAR SUSPENSION	Triangulated swing arm with single spring-damper
FRONT/REAR WHEEL	Cast light alloy
FRONT/REAR TYRE	Yokohama 300-S18, 350-S18
FRONT BRAKE	265mm hydraulic disc, floating caliper
REAR BRAKE	180mm drum
ELECTRICAL SYSTEM	130-watt alternator
BATTERY	12V-5.5Ah
FUEL TANK	16.5 litres (3.6 gal)
DIMENSIONS	Wheelbase 1360mm (53.5in), seat height 800mm (31.2in), castor angle na, trail na, weight 139kg (306lb) dry

that with tuned barrels, Micron pipes and 17/39 gearing, the LC revved to 10,500 rpm and clocked 132.64 mph one way with a mean of 127.3 mph, some eight mph up on a stock 350LC.

AGT 741X was converted back to a 250LC and continued its service into another winter with other mods including a Lockheed front caliper that offered better feel at the handlebar lever and a very trick light-alloy swingarm.

Then one day, someone called from reception downstairs. "Had I let someone have a go on the 250LC?"

"Effing no," I yelled, as I looked out to across the road where the 250LC was usually parked. It was gone. I sprinted down vainly to chase the thief but he'd disappeared into the traffic. We'd been through a lot, the LC and me, and I felt like I'd lost a friend and compatriot. But hey, isn't that what LCs are all about?

Feeling the chill. John gets caught out in the cold on the LC in Mel LeMoto cafe racer bodywork.

Yamaha RD250LC performance data

All figures compiled at Motor Industry Research Association's proving ground, Nuneaton, Warks.

DATE & TEST	Mean top mph	Best one-way, mph	Quarter-mile secs/mph
27 OCTOBER 1981			
250cc comparison test	98.77	102.5	15.45/83.9
21 APRIL 1982			
Noise & exhaust test @ 3,000m Stock exhaust	99.70	99.80	15.60/84.0
Rolling top gear QM:			14.20/84.4
	Noise level: (3rd gear from 30mph) 78.5/87.5db		
Micron	103.3	104.3	
Rolling top gear QM:			13.6/86.6
	Noise level: 91.5dB/99.0dB		
J&R	92.85	92.9	
Rolling top gear QM:			13.9/82.6
	Noise level: 91.5dB/99.0dB		
Allspeed	100.9	101.6	
Rolling top gear QM:			13.5/87.3
	Noise level: 81.0dB/90.5dB		
14 OCTOBER 1982			
Tuning test, top removed from air box	99.52	101.25	14.8/87.74
Rolling quarter			13.46/87.9
240 mains & no air box	100.78	103.45	
18 OCTOBER 1982			
Tuning test Stephens barrels, Hargreaves reeds and Allspeed pipes (240 mains)	106.30	110.91 (10,000)	14.43/93.73
11 NOVEMBER 1982			
Stephens barrels	105.56	111.09	14.18 /91.9
Fresh Yamaha pipes with 16/41 gearing			
Raise gearing to 16/39 with Pirelli Phantom tyre	107.51	113.84	14.52/90.44
220 main jets	107.62	113.94	-
Rich Dickenson barrels with high exhaust port and transfers 16/39 gearing	107.12	112.24	14.34/91.34
	Power smooth from 6,000 to 9,500rpm but less top end power		
190 mains and needle on bottom notch	110.21	112.09	
190 mains with Allspeed pipes, 16/39 gearing	111.44	115.29	14.15/93.45
Standard 16/41 gearing with Dickenson barrels and prototype Allspeed MkII pipes:			13.8s/94.75
Converted to 350LC with prototype Allspeed pipes and 17/39 gearing	121.79mph	126.30mph	13.52s/100.29mph
	(@ 10,000, power from 8,000 to 9,500.)		
350LC with Micron pipes:	127.3mph	132.64mph	13.40s/103.84mph
	(power from 8,000 to 10,500 but revs to 11,000)		
29 JULY 1982	Mel Lemoto equipment at 5,200 miles did 232.7 miles with 22.17 litres (4.87 gal) = 47.8mpg		

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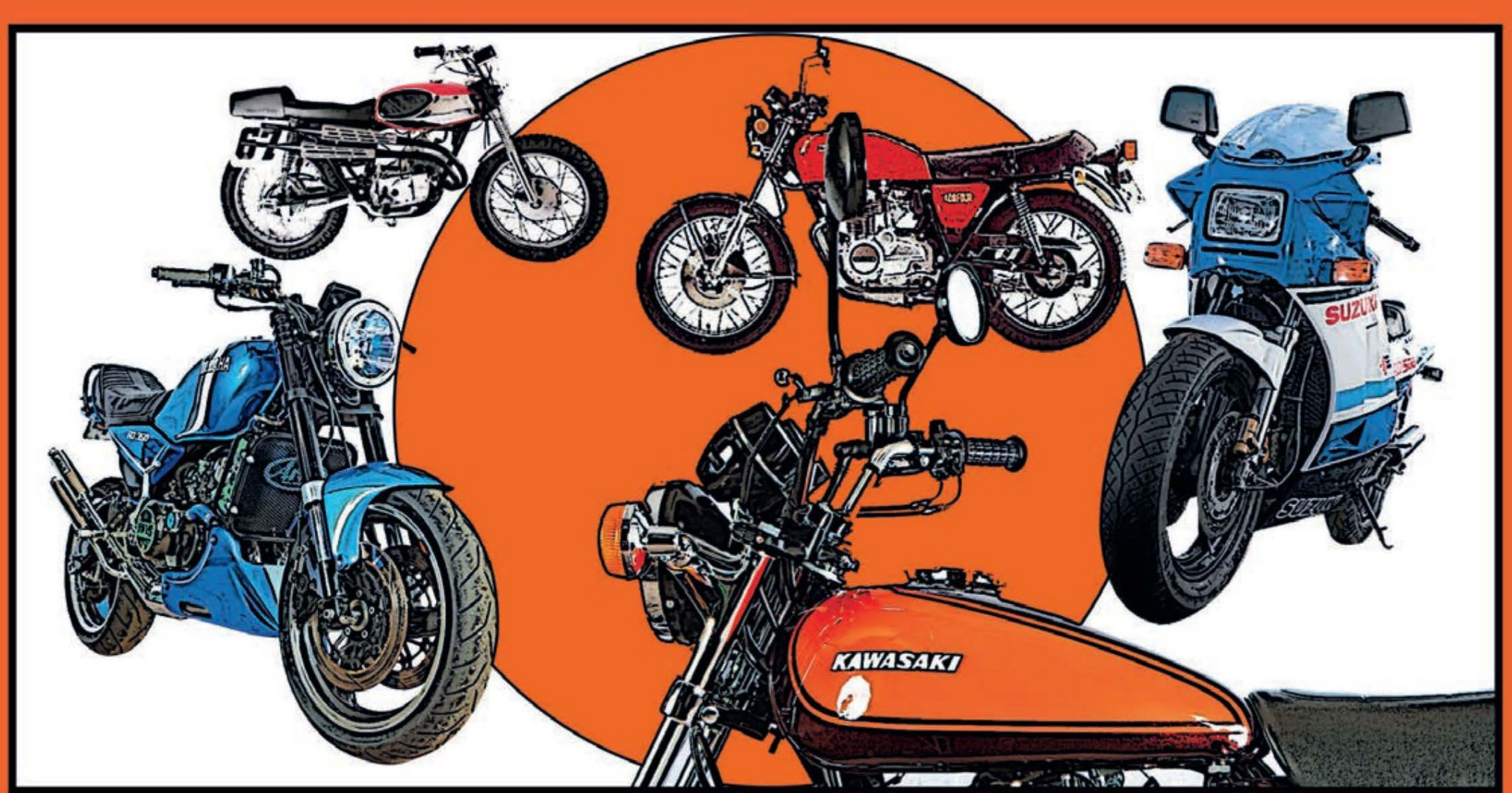

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0 September	National Motor Museum, Beaulieu Collectors' Motorcycles, Motor Cars and Automobilia
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6 October	The Classic Motorcycle Mechanics Show, Stafford Collectors' Motorcycles and Related Memorabilia
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